BeneView T8

Patient Monitor

Service Manual

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Revision History

This manual has a revision number. This revision number changes whenever the manual is updated due to software or technical specification change. Contents of this manual are subject to change without prior notice.

- Revision number: 9.0
- Release time: February 2012

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FOR YOUR NOTES

Preface

Manual Purpose

This manual provides detailed information about the assembling, dissembling, testing and troubleshooting of the equipment to support effective troubleshooting and repair. It is not intended to be a comprehensive, in-depth explanation of the product architecture or technical implementation. Observance of the manual is a prerequisite for proper equipment maintenance and prevents equipment damage and personnel injury.

This manual is based on the maximum configuration; Therefore, some contents may not apply to your monitor. If you have any question, please contact our Customer Service Department.

Intended Audience

This manual is for biomedical engineers, authorized technicians or service representatives responsible for troubleshooting, repairing and maintaining the patient monitors.

Abbreviations

Abbreviations used in this manual are:

MPM	multi-parameter module
SMR	satellite module rack
CMS	central monitoring system
PCB	printed circuit board

Passwords

A password may be required to access different modes within the monitor. The passwords are listed below:

- User maintenance: 888888 (User adjustable)
- Factory maintenance: 332888
- Demo mode: 2088
- Configuration mode: 315666 (User adjustable)

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FOR YOUR NOTES

1 Safety

1.1 Safety Information

⚠DANGER

- **Indicates an imminent hazard that, if not avoided, will result in death or serious injury.**

⚠WARNING

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in death or serious injury.**

⚠CAUTION

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in minor personal injury or product/property damage.**

NOTE

- **Provides application tips or other useful information to ensure that you get the most from your product.**

1.1.1 DANGER

There are no dangers that refer to the product in general. Specific “Danger” statements may be given in the respective sections of this manual.

1.1.2 Warnings

⚠WARNING

- **All installation operations, expansions, changes, modifications and repairs of this product are conducted by Mindray authorized personnel.**
- **There is high voltage inside the equipment. Never disassemble the equipment before it is disconnected from the AC power source.**
- **When you disassemble/reassemble a parameter module, a patient leakage current test must be performed before it is used again for monitoring.**
- **The equipment must be connected to a properly installed power outlet with protective earth contacts only. If the installation does not provide for a protective earth conductor, disconnect it from the power line and operate it on battery power, if possible.**
- **Dispose of the package material, observing the applicable waste control regulations and keeping it out of children’s reach.**

1.1.3 Cautions

⚠CAUTION

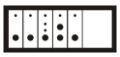
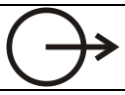
- **Make sure that no electromagnetic radiation interferes with the performance of the equipment when preparing to carry out performance tests. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.**
- **Before connecting the equipment to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the equipment’s label or in this manual.**
- **Protect the equipment from damage caused by drop, impact, strong vibration or other mechanical force during servicing.**

1.1.4 Notes

NOTE

- **Refer to Operation Manual for detailed operation and other information.**

1.2 Equipment Symbols

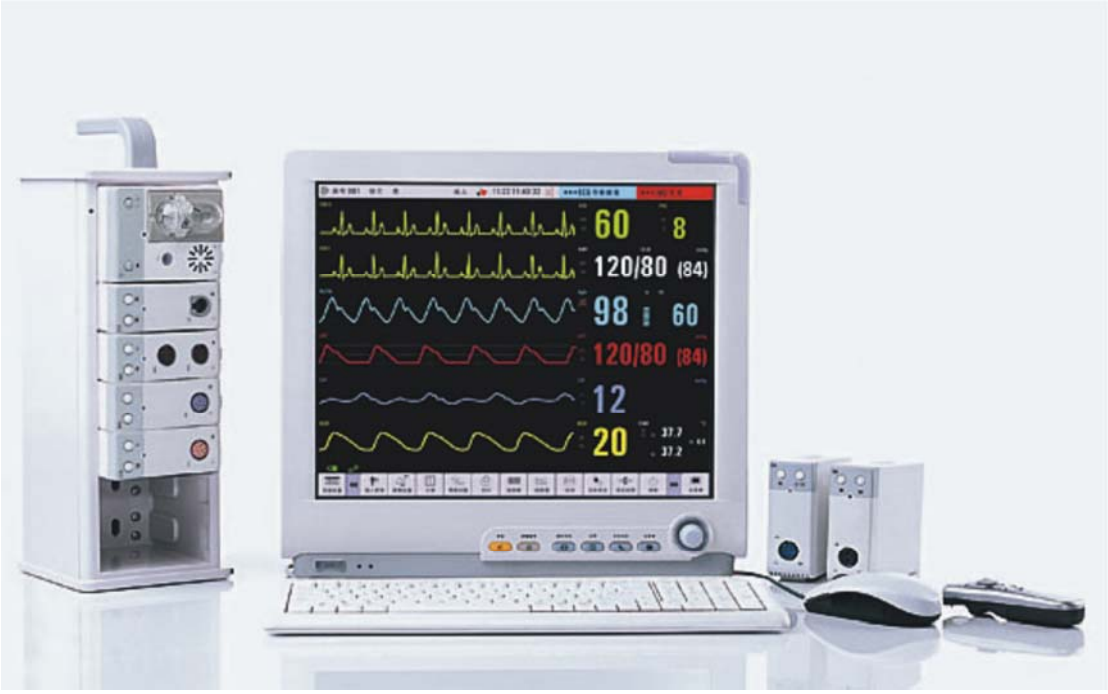
	Attention: Consult accompanying documents (this manual).		CIS connector
	Danger: High-voltage		Network connector
	Alternating current(AC)		Defibrillator connector
	Power ON/OFF		Connector for satellite module rack
	Battery indication		Video output
	Zero key		Auxiliary output connector
	Calibrate key		USB connector
	Measure/Standby		Equipotential terminal
	Check sensor		CE marking
	ESD warning symbol for Electrostatic sensitive devices.		
	Type CF applied part. Defibrillator-proof protection against electric shock.		
	Type BF applied part. Defibrillator-proof protection against electric shock.		

FOR YOUR NOTES

2 Theory of Operation

2.1 Introduction

This patient monitor is designed to monitor a fixed set of physiological parameters including ECG, heart rate (HR), respiration (Resp), temperature (Temp), SpO_2, pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), cardiac output (C.O.), carbon dioxide (CO_2), oxygen (O_2), anesthetic gas (AG), impedance cardiograph (ICG), bispectral index (BIS), respiration mechanics (RM), continuous cardiac output (PiCCO), and central venous oxygen saturation ($ScvO_2$).



The patient monitor also:

- Provides audible and visual alarm indications in case of patient or equipment problems.
- Enables displaying, reviewing, storing and transferring of real-time data.
- Incorporates multiple input devices such as buttons, knob, touchscreen, keyboard and mouse.
- Interfaces a clinical information system or central monitoring system.
- Enables program upgrade over the network.
- Integrates the information of other devices, which include but are not restricted to anesthesia machine and ventilator.

2.2 System Connections

2.2.1 Mounting the Patient Monitor

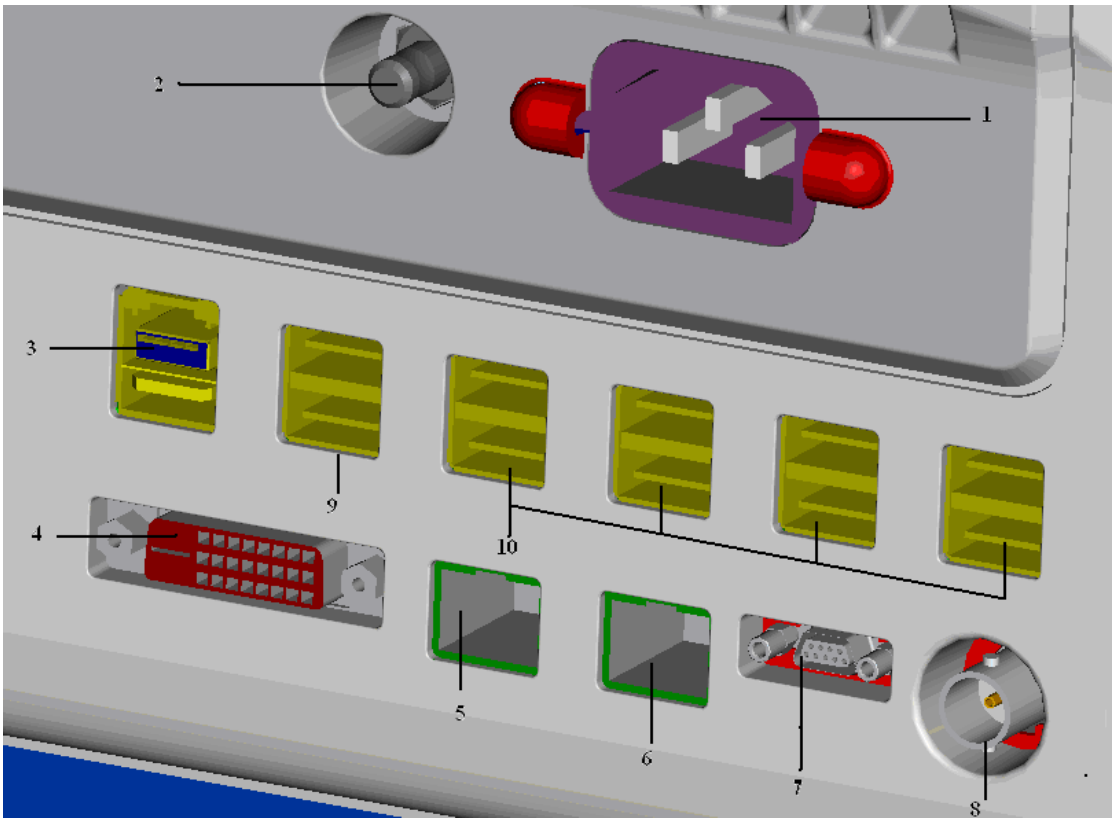
The patient monitor can be mounted on a wall bracket or on a trolley support. The wall bracket or trolley support can be ordered optionally. Each type of mounting bracket is delivered with a complete set of mounting hardware and instructions. Refer to the documentation delivered with the mounting hardware for instructions on assembling mounts.

⚠CAUTION

- **Use mounting brackets we supply or approve. If other compatible mounting bracket is used, be sure it can be safely used on the patient monitor.**
- **The mounting bracket should be installed by our qualified service personnel, or engineers who have adequate knowledge on it.**
- **If other mounting solution is used, the installation personnel and the customer should verify if it can be safely used on the patient monitor, and the customer assume the responsibility for any risk resulting from that.**

2.2.2 Connectors for Peripheral Devices

On the back of the patient monitor you will find all connectors for peripheral devices.



1. AC Power Connector: used to connect an AC power source (100 to 240 VAC, 50/60Hz).
2. Equipotential Terminal: used to connect the equipotential terminal of other equipment, eliminating potential difference between different pieces of equipment.
3. SMR Connector: It outputs a 12V DC, used to connect the SMR.
4. Video Output: It is a DVI-D connector used to connect a secondary display.
5. CIS Connector: It is a RJ45 connector used to connect a CIS.
6. Network Connector: It is a RJ45 connector used to connect an ethernet network or a PC.
7. Analog Output and Defibrillator Connector: It is a Micro-D connector used to output analog signals and defibrillator synchronization signals.
8. Auxi Output Connector: It is a BNC connector used to output nurse call signals.
9. Secondary USB Connector: used to connect the mouse and keyboard of the secondary display.
10. General USB Connector: used to connect any USB-compatible peripheral device.

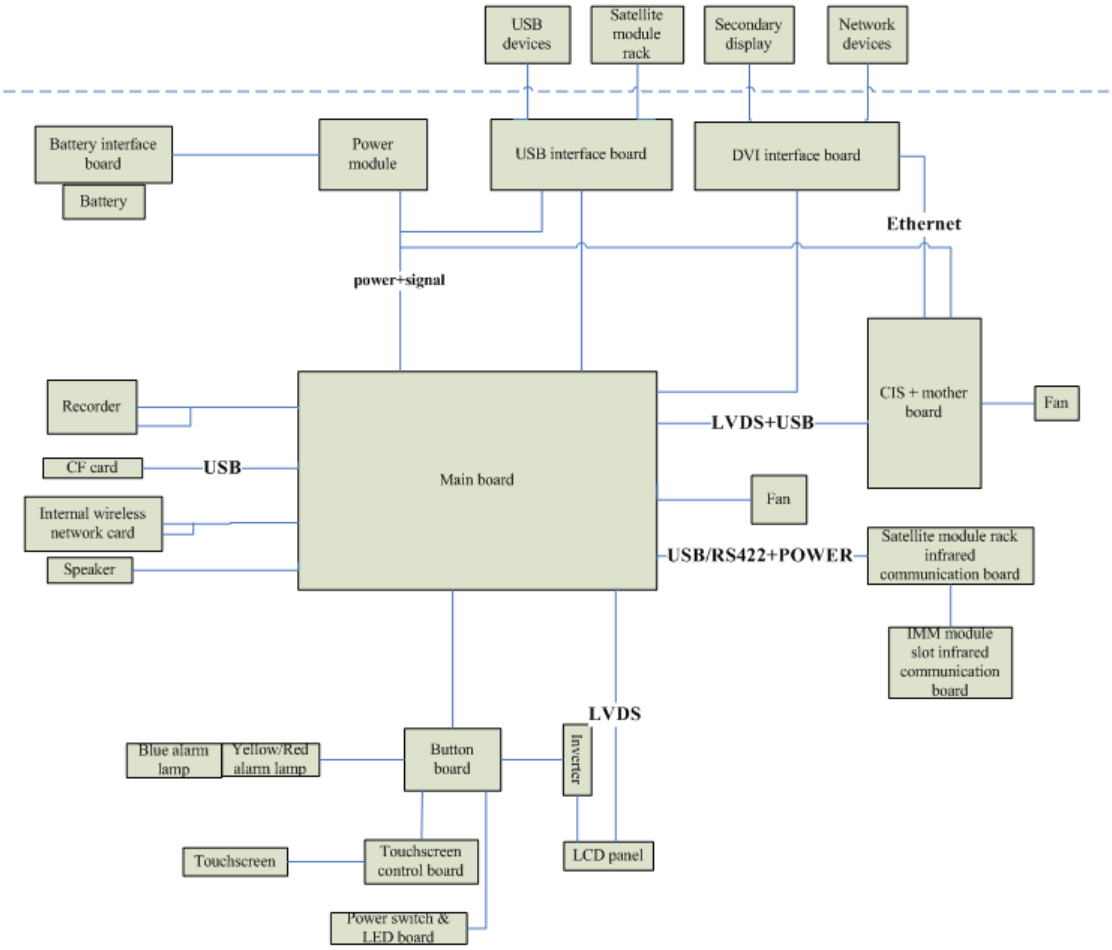
2.3 Main Unit

The patient monitor consists of:

- Input system: button board, knob, touchscreen, power switch and LED board
- Output system: LCD panel, alarm LED board, recorder, speaker
- Processing and communications system: main board, CIS assembly, integral module rack
- Power management system: battery, battery interface board, power module
- Equipment interface system: USB interface board, DVI interface board, CF card assembly and internal wireless network card.

Additionally, the patient monitor can also connect satellite module rack (SMR), parameter modules, BeneLink module, mouse, keyboard, etc.

The following diagram illustrates the structure of the patient monitor.



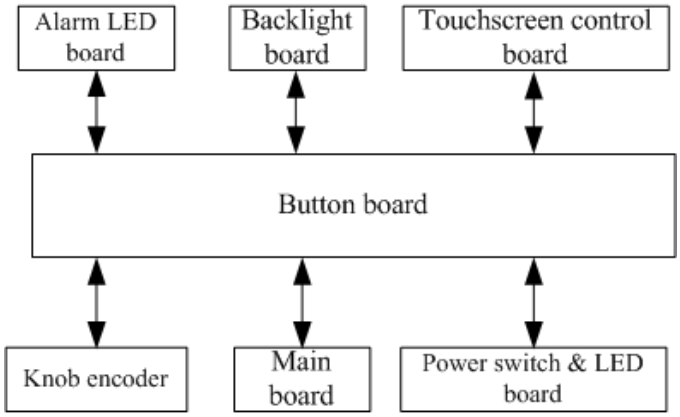
2.3.1 Input System

Button board

The button board, located at the lower part of the monitor's front panel, contains 6 keys and provides connections for the following components to the main board:

- Knob
- Power switch & LED board
- Touchscreen control board
- Backlight board
- Alarm LED board

The following diagram shows the button board connections.



Knob

The knob can be pressed, or rotated both clockwise and counter-clockwise. It is connected with the button board.

Touchscreen

The touchscreen enables touch operations and can be calibrated. It is connected with the touchscreen control board and main board.

Power switch & LED Board

The power switch & LED board controls the power supply for the main unit. It has three LEDs, which respectively indicate the AC power status, battery status and monitor power on/off status. It is connected with the button board.

2.3.2 Output System

LCD

The patient monitor adopts a high-resolution LCD. The LCD is connected with the main board. Signals and power supply of the backlight board are transferred by the button board.

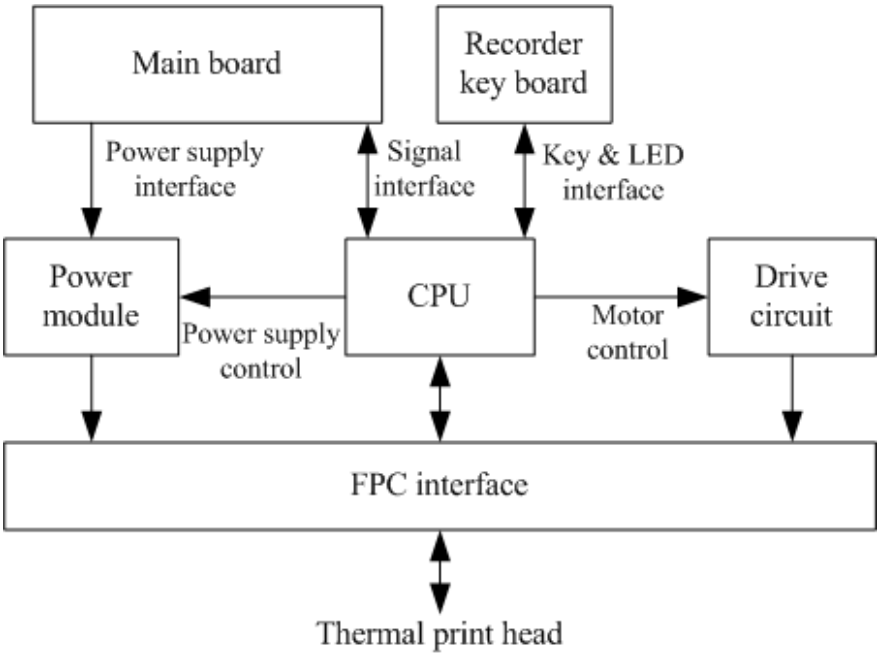
Alarm Lamp

The patient monitor has two alarm lamps: alarm lamp and technical alarm lamp. Alarm lamp lights either red or yellow whereas technical alarm lamp lights blue only. The signals from the alarm lamps are transferred by the button board and are controlled directly by the main board.

Recorder

The recorder receives data coming form the main board and then sends them to the thermal printhead for printing. The recorder has a hardkey (starting/stopping recordings) and a green LED on its front. It is connected with the main board.

The following diagram shows its operating principle.



Module	Description
Power interface	Introduces a DC from the main board.
Power module	Converts the input power into voltages that fit each module and then forwards them to each module.
CPU	Control the communications between modules.
Signal interface	Control the communications between the main board and the recorder CPU.
Motor drive circuit	Receives the control signals from the CPU and then forwards them to the step engines.
Button & LED board	Includes one button and one LED which are directly controlled by the CPU.

Speaker

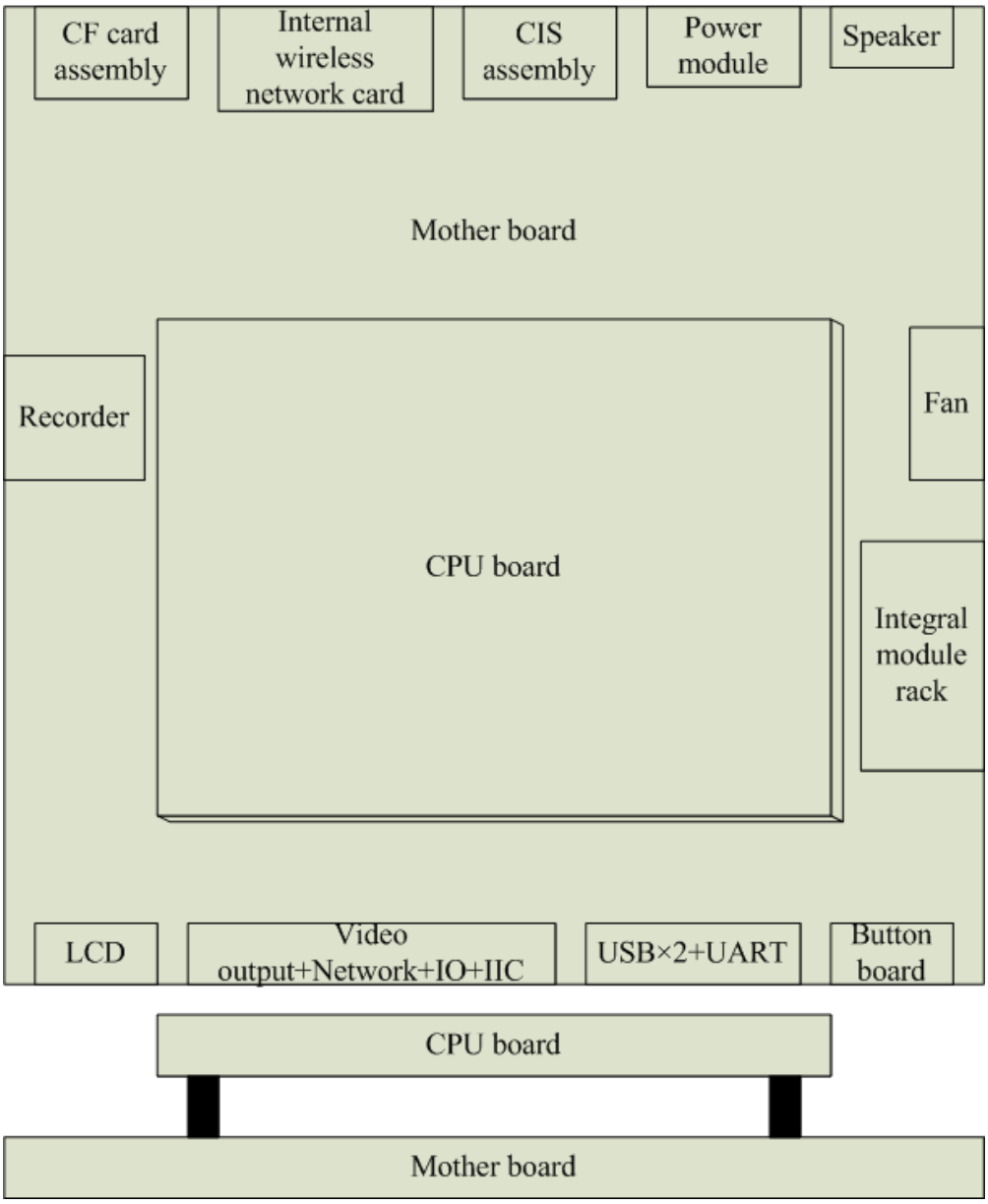
The speaker provides sound for alarms, key strokes, heart beats and pulse, and allows PITCH TONE and multi-level tone modulation. It is connected with the main board and is directly driven by the main board.

2.3.3 Processing and Communications System

Main Board

The main board is the heart of the patient monitor. It implements a series of tasks including input & output control, data storage and processing, display processing, system control, communication management, printing management and alarming, etc.

The main board comprises the CPU board and mother board. The following diagram shows interfaces to other components.



The CPU board is an essential CPU system containing the CPU, FLASH, memory, realtime clock, EEPROM, etc. It interfaces to the mother board only, which then provides interfaces to all other external devices.

The mother board is in charge of connections and communications with other components and provides the following interfaces:

- LCD port: connects a built-in display.
- Video output+network+IO+IIC: connects the digital video interface board.
- USB×2+UART: connects the USB interface board.
- Button board port: connects the button board.
- Integral module rack port: connects integral module rack communication board.
- Fan port: connects the fan.

- Speaker port: connects the speaker.
- Power module port: connects the power module.
- CIS port: located at the back of the mother board for connecting the CIS components.
- CF port: connects the CF card assembly.
- Recorder port: connects the recorder.
- Internal wireless network card port: connects the internal wireless network card

Integral Module Rack

The patient monitor has two kinds of integral module rack: 2-slot and 5-slot. The control board includes a NIOS II FPGA. It implements protocol conversion and infrared communication between the main unit and the parameter modules.

The module rack communication board can be a 2-slot type or a 3-slot type. The 3-slot communication board communicates the main board directly. The 2-slot communication board is connected with and is controlled by the 3-slot communication board. The 3-slot communication board has the function of communication control. The 2-slot communication board consists of the infrared circuit and module power circuit. The RS422 drive circuit is located on the 3-slot communication board.

2.3.4 Power Management System

Battery

The patient monitor uses two chargeable lithium-ion batteries (11.1 V, 4500 mAh). The battery compartment door is located at the bottom of the patient monitor. The battery power is introduced to the power module via the battery interface board, and then processed and distributed to each component by the power module.

NOTE

- **Two batteries must be used simultaneously when the patient monitor operates on battery power. Otherwise, it may cause power supply protection.**

Battery Interface Board

The battery interface board connects batteries to the power module, enabling charging and discharging between the batteries and the power board.

Power Module

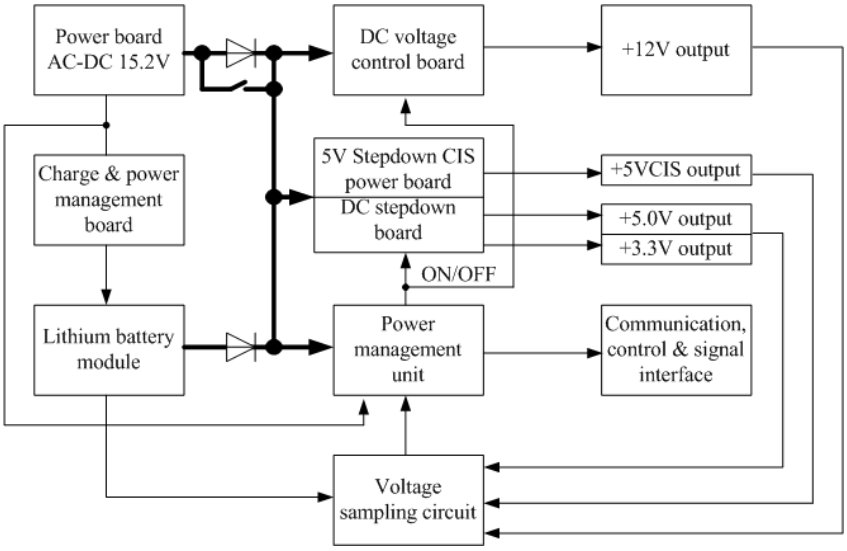
The power module is located at the back of the patient monitor. The main part of the power module is the power board, which contains 4 PCBs: charging & power management board, voltage drop DC inverter, voltage rise and drop DC inverter, and voltage drop 5 V CIS power board.

The power module transforms the input power into DC and then forwards them to each component of the patient monitor. The input power comes from either the batteries or an AC source. The patient monitor will run power from the AC source whenever an AC source is available. If the AC source becomes unavailable, the patient monitor will automatically switch to the battery power. This does not affect the monitor's operating status.

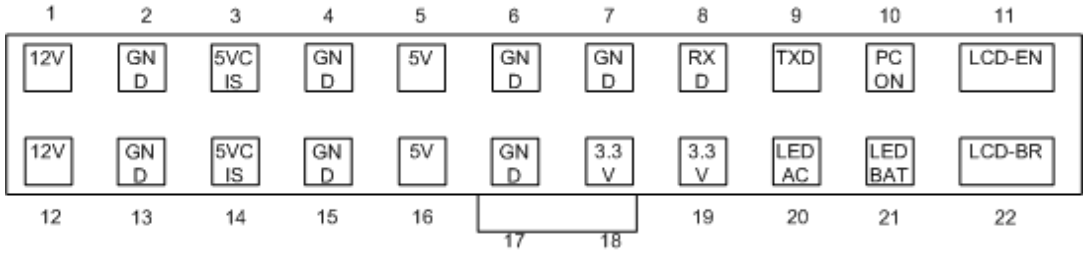
Power module has an AC input socket at its backside, and a socket at its front provides 4 connections to the batteries, main board, CIS components and USB interface board respectively. The power module protects itself and the patient monitor by switching off AC input or DC output in case of overcurrent, short circuit and overvoltage.The power module provides 4 DC outputs:

Outputs	Description
+3.3 V	Goes to the LCD, mother board, CPU board, DVI interface board and integral module rack.
+5.0 V	Goes to the DVI interface board, recorder, CF storage card board and USB interface board.
+5.0 V CIS	Goes to the CIS assembly.
+12 V	Goes to the recorder, LCD inverter, integral module rack, parameter modules and USB interface board.

The systematic principle diagram of the power module is as follows:



The following diagram shows the pins of the power module socket (excluding the pins of the battery power socket. On power board, pin 1 has a triangle symbol):

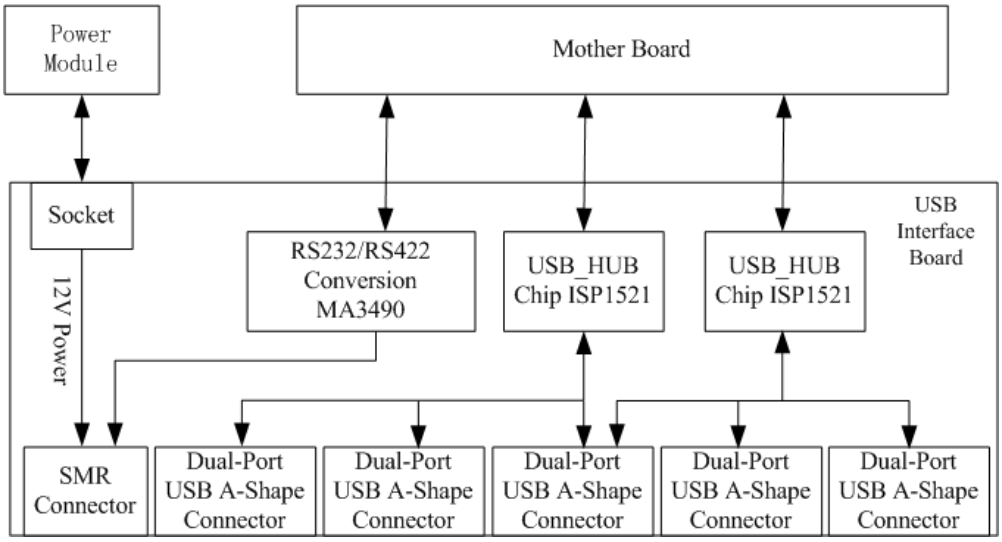

1 2 3 4 5 6 7 8 9 10 11
12V GND 5VCIS GND 5V GND GND RXD TXD PCON LCD-EN
12V GND 5VCIS GND 5V GND 3.3V 3.3V LEDAC LEDBAT LCD-BR
12 13 14 15 16 17 18 19 20 21 22

Pin ID	Marking	Description	Cable color
2, 4, 6, 7, 13, 15, 17	GND	The output grounding terminal of the power board.	Black
8	RXD	Receives serial communications (the main board sends).	Purple
9	TXD	Sends serial communications (the main board receives).	Brown
10	PCON	Power on/off control signal. It is a TTL pulse signal inputted from the back board. Every time when the power on/off switch is pressed (pulse of falling edge), a switch between power “on” and “off” happens. The pulse duration is no less than 0.1 s for power-on and no less than 2 s for power off.	Blue
11	LCD-EN	Backlight on/off control signal. The main board sends a backlight on/off control signal to the power board through the serial interface. The power board processes the received signal and then outputs a high or low level depending on the received signal.	Green
12, 1	12 V	The positive end of the 12 V DC coming from the power board.	Yellow
14, 3	5 V CIS	The positive end of the 5 V CIS coming from the power board.	Purple
16, 5	5 V	The positive end of the 5 V DC coming from the power board.	Red
18, 19	3.3 V	The positive end of the 3.3 V DC coming from the power board.	Orange
20	LED- AC	AC power status indication signal	White
21	LED- BAT	Battery status indication signal.	Grey
22	LCD-BR	Backlight brightness control voltage.	Brown

2.3.5 Equipment Interface System

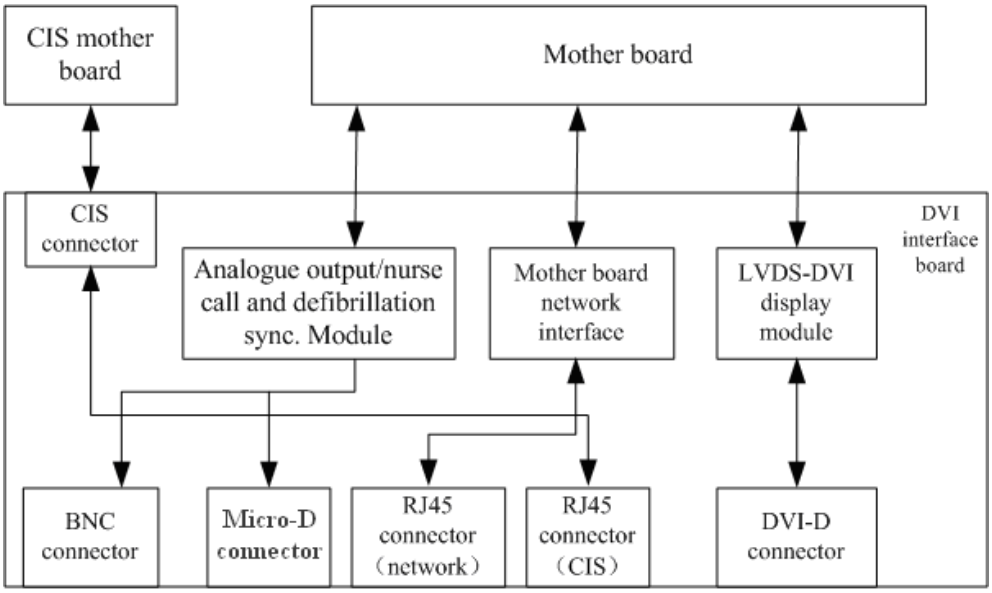
USB Interface Board

The USB interface board is compatible with such USB interfaces as USB2.0, USB1.1 and USB1.0. It is connected with the main board and the power module. It receives two USB differential signals coming from the main board and then distributes them to ten USB interfaces via two ISP1521 chips. The UART signal output by the main board is converted into RS422 signal by the USB interface board. The USB interface board receives 5 VDC and 12 VDC inputs from the power module, of which the 5 VDC goes to the USB interface board and the 12 VDC outputted to the SMR connector through a fuse.



DVI Interface Board

The DVI interface board is connected with the mother board and the CIS mother board. The following diagram shows its interfaces to other components.



Interface	Description
CIS Connector	Connects the CIS mother board.
BNC connector	Outputs nurse call signals.
Micro-D connector	Outputs analog signals and defibrillator synchronization signals.
RJ 45 connector (network)	It is a standard RJ45 connector, providing 10/100 BASE-TX Ethernet communications channels. It connects an Ethernet network or a PC.
RJ 45 connector (CIS)	It is a standard RJ45 connector for connecting a CIS network.
DVI-D connector	Connects a secondary display.

CF Card assembly

The CF assembly serves the non-volatile CF storage card which is used for data storage and transfer. It is connected with the mother board.

Internal wireless network card

The internal wireless network card connects with the mother board. User can set network type as LAN or WLAN through user interface and can set the internal wireless network card through PC.

2.4 Parameter Module

Each parameter module consists of the module infrared communication board, module power board, module button board, parameter board, etc.

2.4.1 Module Infrared Communication Board

The module infrared communication board allows a short delay when powering up the module and adopts FPGA to enable infrared communications between the module and the module rack. An ID is integrated into the module infrared communication board. When a module is inserted in the module rack, the ID is automatically sent to the module rack.

2.4.2 Module Power Board

Some modules have no power board. There are two kinds of module power board:

1. Isolated power board: converts the 12 V DC into a 12 V isolated DC and a 5 V isolated DC.
2. Non-isolated power board: converts the 12 V DC into a 5 V DC.

2.4.3 Parameter Board

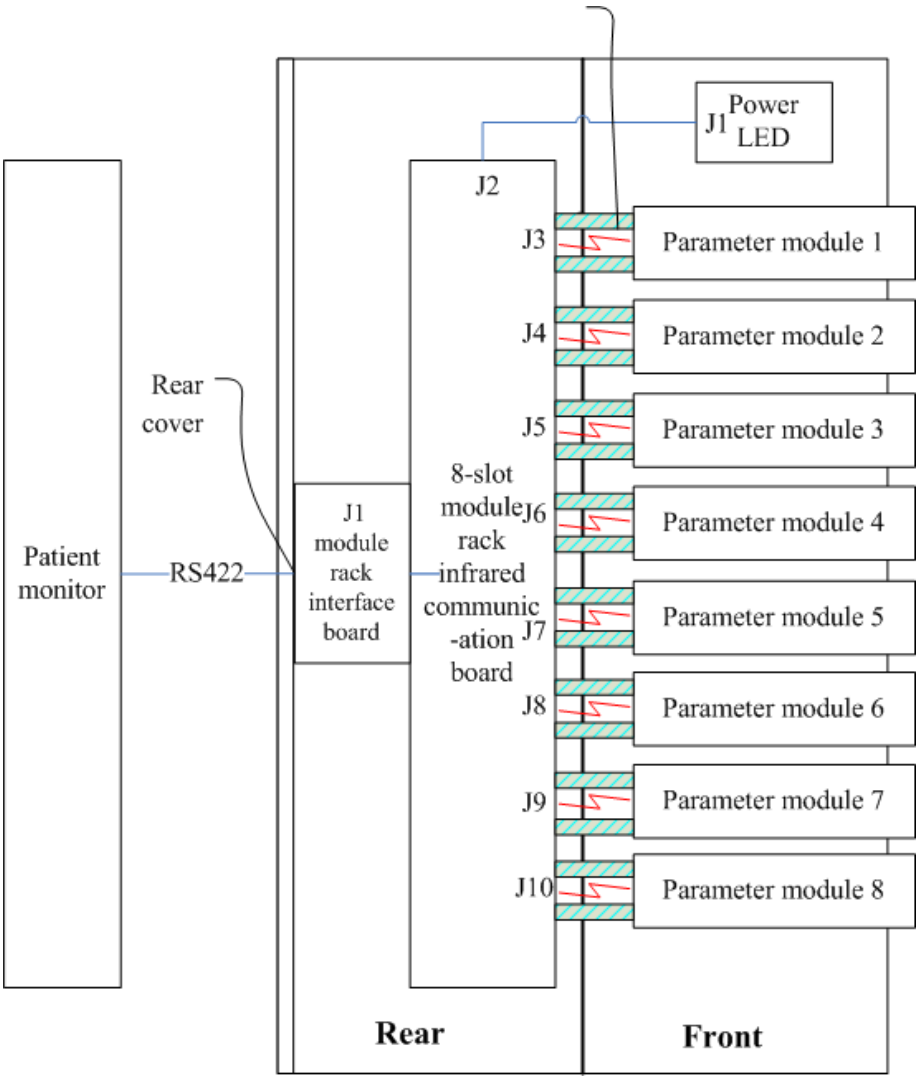
The parameter board is a parameter measurement component, which is the most important component of the parameter module.

2.5 Satellite Module Rack

The satellite module rack (SMR) is independent of the patient monitor, provides 8 slots for mounting parameter modules. It has the following features:

- It allows a parameter module to be plugged and unplugged with the patient monitor on. This allows function extension and patient transfer.
- It does not have its own power. It introduces 12 V DC from the patient monitor and then supplies power to each parameter module via the contact screw.
- It accomplishes communications protocol conversions between the patient monitor and each parameter module, provides infrared communications for parameter modules, and is responsible for detecting infrared communications malfunction for each parameter module.

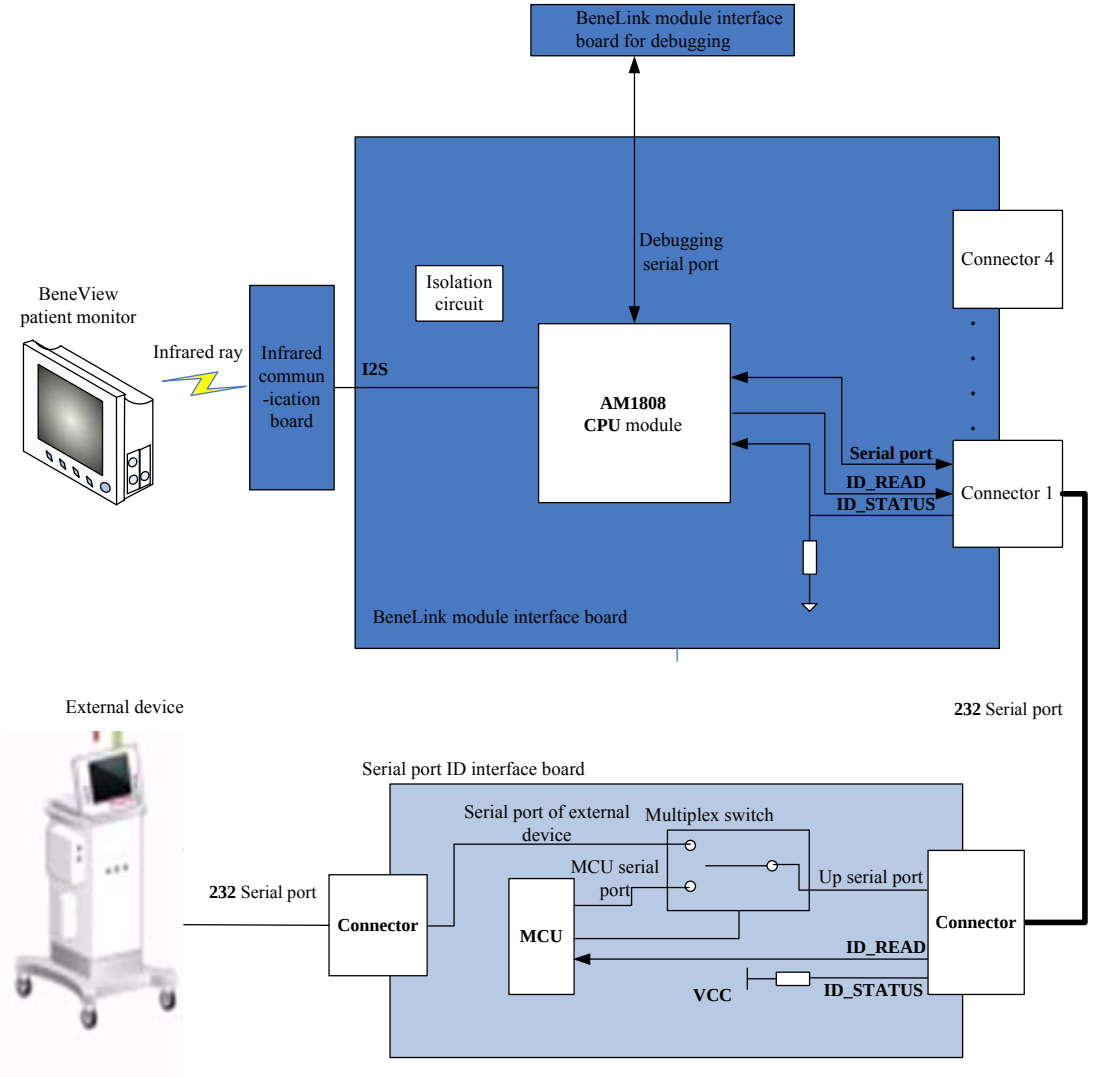
The following diagram shows the structure of the SMR.



2.6 BeneLink Module

BeneLink module allows the information (patient data, alarms, etc.) from the external device to be displayed, saved, recorded, printed, or calculated through a BeneView patient monitor. If the patient monitor is connected with the CMS or gateway, information from the external device can also be transmitted to the CMS or gateway. BeneLink module connects with the external device through an ID module, which enables the information transmission between the BeneLink module and the external device. BeneLink module can be connected to many external devices such as anesthesia machine and ventilator.

The following diagram shows the structure of the BeneLink module:



3 Testing and Maintenance

3.1 Introduction

To ensure the patient monitor always functions normally, qualified service personnel should perform regular inspection, maintenance and test. This chapter provides a checklist of the testing procedures for the patient monitor with recommended test equipment and frequency. The service personnel should perform the testing and maintenance procedures as required and use appropriate test equipment.

The testing procedures provided in this chapter are intended to verify that the patient monitor meets the performance specifications. If the patient monitor or a module fails to perform as specified in any test, repairs or replacement must be done to correct the problem. If the problem persists, contact our Customer Service Department.

⚠CAUTION

- **All tests should be performed by qualified service personnel only.**
- **Care should be taken to change the settings in [User Maintenance] and [Factory Maintenance] menus to avoid loss of data.**
- **Service personnel should acquaint themselves with the test tools and make sure that test tools and cables are applicable.**

3.1.1 Test Equipment

See the following sections.

3.1.2 Test Report

Upon completion of the tests, the table of preventative maintenance test reports and the table of maintenance test reports in this chapter should be kept properly.

3.1.3 Preventative Maintenance

Below are preventative maintenance tests which need to be performed on the monitor. See the following sections for detailed maintenance procedures.

- Visual inspection
- NIBP test and calibration
- Microsteam and Sidestram CO_2 test and calibration
- AG test and calibration

3.1.4 Recommended Frequency

<table>
<tr><th colspan="2">Check/Maintenance Item</th><th>Frequency</th></tr>
<tr><td colspan="3">Preventative Maintenance Tests</td></tr>
<tr><td colspan="2">Visual inspection</td><td>1. When first installed or reinstalled.</td></tr>
<tr><td rowspan="3">NIBP test</td><td>Pressure check</td><td rowspan="9">1. If the user suspects that the measurement is incorrect.
2. Following any repairs or replacement of relevant module.
3.At least once a year is recommended for NIBP, CO_2 and AG.</td></tr>
<tr><td>Leakage test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td rowspan="3">Sidestream and Microstream CO_2 tests</td><td>Leakage test</td></tr>
<tr><td>Performance test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td rowspan="3">AG tests</td><td>Leakage test</td></tr>
<tr><td>Performance test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td colspan="3">Performance Tests</td></tr>
<tr><td rowspan="2">ECG test</td><td>Performance test</td><td rowspan="3">1. If the user suspects that the measurement is incorrect.
2. Following any repairs or replacement of relevant module.</td></tr>
<tr><td>Calibration</td></tr>
<tr><td colspan="2">Resp performance test</td></tr>
</table>

<table>
<tr><td colspan="2">SpO_2 test</td><td rowspan="15">3. At least once every two years.
Note: At least once a year is recommended for NIBP, CO_2 and AG.</td></tr>
<tr><td rowspan="3">NIBP test</td><td>Pressure check</td></tr>
<tr><td>Leakage test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td colspan="2">Temp test</td></tr>
<tr><td rowspan="2">IBP test</td><td>Performance test</td></tr>
<tr><td>Pressure calibration</td></tr>
<tr><td colspan="2">C.O. test</td></tr>
<tr><td colspan="2">Mainstream CO_2 test</td></tr>
<tr><td rowspan="3">Sidestream and Microstream CO_2 tests</td><td>Leakage test</td></tr>
<tr><td>Performance test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td rowspan="3">AG tests</td><td>Leakage test</td></tr>
<tr><td>Performance test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td colspan="2">ICG test</td></tr>
<tr><td colspan="2">BIS test</td></tr>
<tr><td colspan="2">RM test</td></tr>
<tr><td rowspan="2">CCO/SvO_2 test</td><td>Interconnecting function</td></tr>
<tr><td>Output calibration</td></tr>
<tr><td colspan="2">PiCCO test</td></tr>
<tr><td colspan="2">$ScvO_2$ test</td></tr>
<tr><td colspan="2">Nurse call relay performance test</td><td rowspan="2">If the user suspects that the nurse call or analog output does not work well.</td></tr>
<tr><td colspan="2">Analog output performance test</td></tr>
<tr><td colspan="3">Electrical Safety Tests</td></tr>
<tr><td>Electrical safety tests</td><td>Refer to A Electrical Safety Inspection.</td><td>1. Following any repair or replacement
2. After the monitor drops.
3. At least once every two years.</td></tr>
</table>

Other Tests		
Power on test		1. When first installed or reinstalled. 2. Following any maintenance or the replacement of any main unit parts.
Touchscreen calibration		1. When the touchscreen appears abnormal. 2. After the touchscreen is replaced.
Recorder check		Following any repair or replacement of the recorder.
Network print test		1. When first installed. 2. Whenever the printer is serviced or replaced.
Device integration check		1. When first installed. 2. Following any repair or replacement of the external device.
Battery check	Functionality test	1. When first installed. 2. Whenever a battery is replaced.

3.2 Preventative Maintenance Procedures

3.2.1 Visual Inspection

Inspect the equipment for obvious signs of damage. The test is passed if the equipment has no obvious signs of damage. Follow these guidelines when inspecting the equipment:

- Carefully inspect the case, display screen, buttons and knob for obvious signs of damage.
- Inspect the SMR and parameter modules for obvious signs of damage.
- Inspect the power cord, wall-mount bracket and module accessories for obvious signs of damage
- Inspect all external connections for loose connectors, bent pins or frayed cables.
- Inspect all connectors on the equipment for loose connectors or bent pins.
- Make sure that safety labels and data plates on the equipment are clearly legible.

3.2.2 NIBP Tests

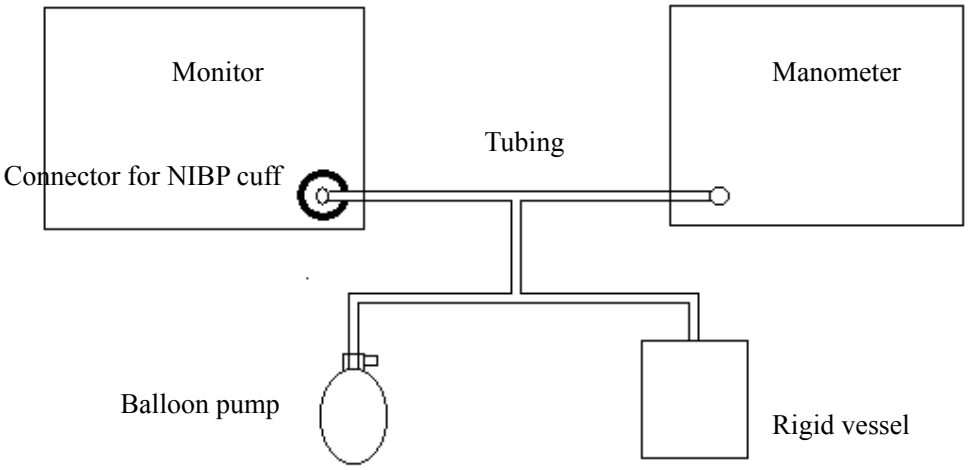
NIBP Accuracy Test

Tools required:

- T-shape connector
- Appropriate tubing
- Balloon pump
- Rigid Vessel with volume 500 ± 25 ml
- Reference manometer (calibrated with accuracy equal to or greater than 1 mmHg)

Follow this procedure to perform the test:

1. Connect the equipment as shown below.



2. Before inflation, the reading of the manometer should be 0. If not, turn off the balloon pump to let the whole airway open to the atmosphere. Turn on the balloon pump after the reading is 0.
3. Select [**Main Menu**]→ [**Maintenance >>**]→ [**NIBP Accuracy Test**].
4. Check the manometer values and the monitor values. Both should be 0mmHg.
5. Raise the pressure in the rigid vessel to 50 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable.
6. Compare the manometer values with the monitor values. The difference should be 3 mmHg. If it is greater than 3 mmHg, calibrate the monitor by referring to the ***NIBP Calibration*** section.
7. Raise the pressure in the rigid vessel to 200 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable and repeat step 6.

NOTE

- **You can use an NIBP simulator to replace the balloon pump and the reference manometer to perform the test.**
- **You can use an appropriate cylinder and a cuff instead of the rigid vessel.**

NIBP Leakage Test

NOTE

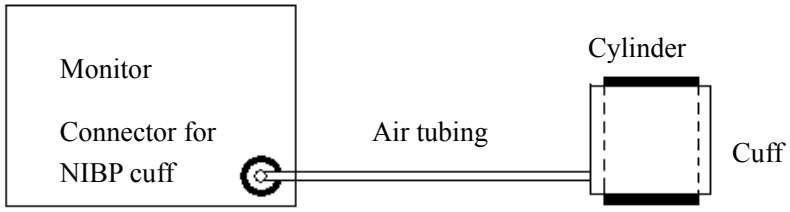
- **You should perform NIBP accuracy test and make sure the test result is pass prior to NIBP leakage test.**

Tools required:

- NIBP cuff for adult patient
- Appropriate tubing
- Cylinder

Follow this procedure to perform the test:

1. Set [**Patient Cat.**] to [**Adu**].
2. Connect the NIBP cuff with the NIBP connector on the monitor.
3. Apply the cuff to the cylinder as shown below.



4. Select [**Main Menu**]→ [**Maintenance>>**]→ [**NIBP Leakage Test**]. The message [**Leakage Testing**…] is displayed in the NIBP parameter area.
5. The cuff automatically deflates after 20s, which means NIBP leakage test is completed.

If no message is displayed in the NIBP parameter area, it indicates that the system has no leakage. If the message [NIBP Pneumatic Leak] is displayed, it indicates that the system may have a leakage. In this case, check if all connections are good and the cuff and tubing have no leakage. Perform the test again after making sure all connections are good and the cuff and tubing have no leakage.

You can either perform a manual leakage test:

1. Perform procedures 1-4 in the ***NIBP Accuracy Test*** section.
2. Raise the pressure in the rigid vessel to 250 mmHg with the balloon pump. Then, wait for 5 seconds to let the measured values becoming stable.
3. Record the current pressure value and meanwhile use a time counter to count time. Then, record the pressure value after counting to 60s.
4. Compare the two values and make sure the difference should not be greater than 6 mmHg.

NIBP Calibration

Tools required:

- T-shape connector
- Approprating tubing
- Balloon pump
- Metal Vessel with volume 500 ± 25 ml
- Reference manometer (calibrated with accuracy equal to or greater than 1 mmHg)

Follow this procedure to perform a NIBP calibration:

1. Perform procedures 1-4 in the ***NIBP Accuracy Test*** section.
2. Select [**Main Menu**]→ [**Maintenance >>**]→ [**Factory Maintenance >>**]→ enter the required password→ [**Calibrate NIBP >>**].
3. Set [**NIBP Pressure**] to 150 mmHg in the [**NIBP Measurement Circuit**]. Raise the pump pressure to 150 mmHg. After the pressure value is stabilized, select the [**Calibrate**] button to start a calibration.
5. Set patient category to [**Adu/Ped**] in the [**Overpressure Protection Circuit**], and raise the pressure to 330 mmHg. After the pressure value is stabilized, select [**Calibrate**] to start a calibration.
6. Set the patient category to [**Neo**] in the [**Overpressure Protection Circuit**], and raise the pressure to 165 mmHg. After the pressure value is stabilized, select [**Calibrate**] to start a calibration.

All calibration results are displayed in the [**Calibrate NIBP**] menu. If the calibration fails, check the test system for leakage and perform another calibration.

3.2.3 Sidestream and Microstream CO_2 Module Tests

Leakage test

Follow this procedure to perform the test:

1. Plug the module into the module rack.
2. Wait until CO_2 warmup is finished and then use your hand or other objects to completely block the gas inlet of the module or watertrap. The sidestream and microstream CO_2 modules will behave as follows:
   - Sidestream: The alarm message [**CO_2 FilterLine Err**] is displayed on the screen after certain time. Block the gas inlet for another 30 s. If the alarm message does not disappear, it indicates that the module does not leak.
   - Microstream: The alarm message [**CO_2 Purging**] is displayed on the screen after certain time. Block the gas inlet for another 30s. If alarm message [**CO_2 FilterLine Err**] is shown, it indicates that the module does not leak.

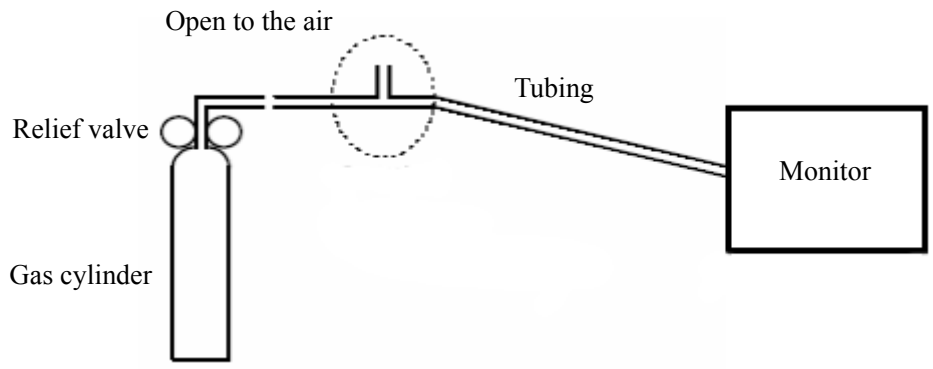
Accuracy Test

Tools required:

- A steel gas cylinder with 6±0.05% CO_2 and balance gas N_2
- T-shape connector
- Tubing

Follow this procedure to perform the test:

1. Plug the module into the module rack.
2. Wait until the CO_2 module warmup is finished, and check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.
3. Enter [**User Maintenance**]→ [**Maintain CO_2 Purging**]→ [**Calibrate CO_2>>**].
4. Connect the test system as follows:



5. Open the relief valve to vent standard CO_2 and make sure that there is an excess gas flow through the T-shape connector to air..
6. Check the realtime CO_2 value is within 6±0.05% in the [**Calibrate CO_2**] menu.

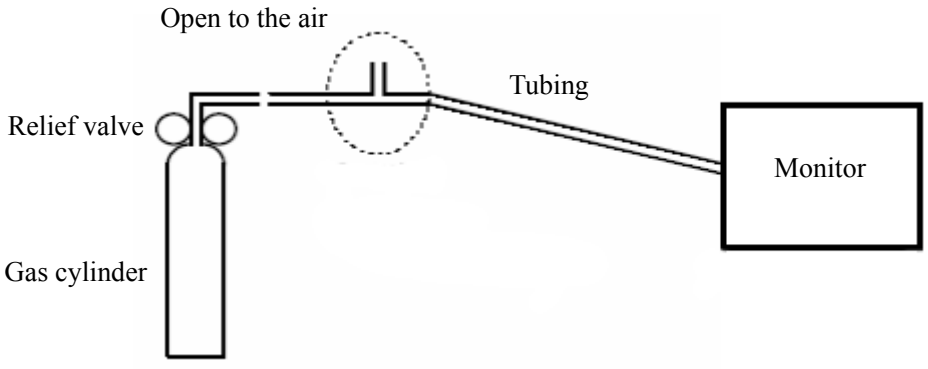
Calibration

Tools required:

- A steel gas cylinder with 6±0.05% CO_2 and balance gas N_2
- T-shape connector
- Tubing

Follow this procedure to perform a calibration:

1. Make sure that the sidestream or microstream CO_2 module has been warmed up or started up.
2. Check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.
3. Select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance** >>]→ enter the required password→ [**Maintain CO_2 >>**]→ [**Calibrate CO_2 >>**].
4. In the [**Calibrate CO_2**] menu, select [**Zero**].
5. After the zero calibration is finished successfully, connect the equipment as follows:



6. Open the relief valve to vent standard CO_2 and make sure that there is an excess gas flow through the T-shape connector to air.
7. In the [**Calibrate CO_2**] menu, enter the vented CO_2 concentration in the [**CO_2**] field.
8. In the [**Calibrate CO_2**] menu, the measured CO_2 concentration is displayed. After the measured CO_2 concentration becomes stable, select [**Calibrate CO_2**] to calibrate the CO_2 module.

If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed in the [**Calibrate CO_2**] menu. If the calibration failed, the message [**Calibration Failed!**] is displayed. In this case, perform another calibration.

3.2.4 AG Tests

Leakage Test

Follow this procedure to perform the test:

1. Plug the AG module into the module rack.
2. Wait until the AG module warmup is finished and then use your hand or other objects to completely block the gas inlet of the AG module. An alarm message [**AC Airway Occluded**] will appear on the screen.
3. Block the gas inlet for another 30 s. If the alarm message does not disappear, it indicates that the module does not leak.

Accuracy Test

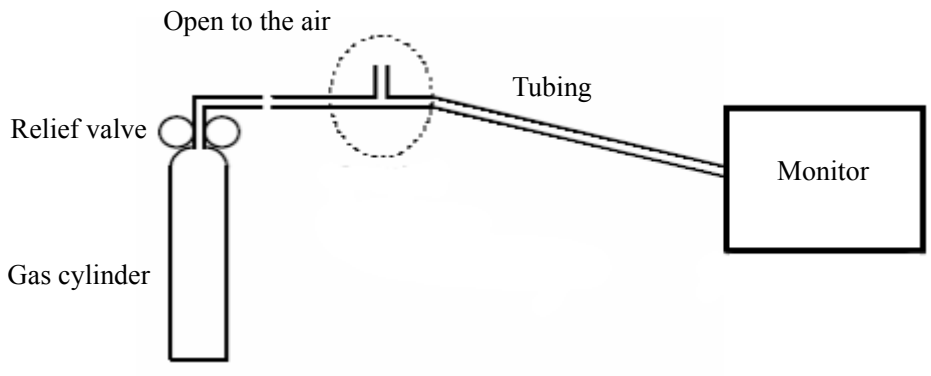
Tools required:

- Gas cylinder with 100% O_2 and a certain standard gas (such as 6±0.05% CO_2,Bal N2), or standaerd gas mixture. Gas concentration should meet the following requirements :

  AA≥1.5%, CO_2≥1.5%, N_2O≥40%, O_2≥40%, of which AA represents an anesthetic agent. a/c≤0.01 (a is the gas absolute concentration accuracy; c is the gas concentration）
- T-shape connector
- Tubing

Follow this procedure to perform the test:

1. Plug the AG module into the module rack.
2. Wait at least 10 min and then perform a leakage test to make sure the airway has no leakage.
3. Check if the fan inside the AG module works correctly.
4. Connect the test system as follows:



5. Open the relief valve and vent a standard gas and make sure that there is an excess gas flow through the T-shape connector to air.
6. Check that the concentration of each composition meets the specification stated in the Operator's Manual.

⚠WARNING

- **When performing AG accuracy test and AG calibration, be sure to dispose of exhaust gas properly.**

Calibration

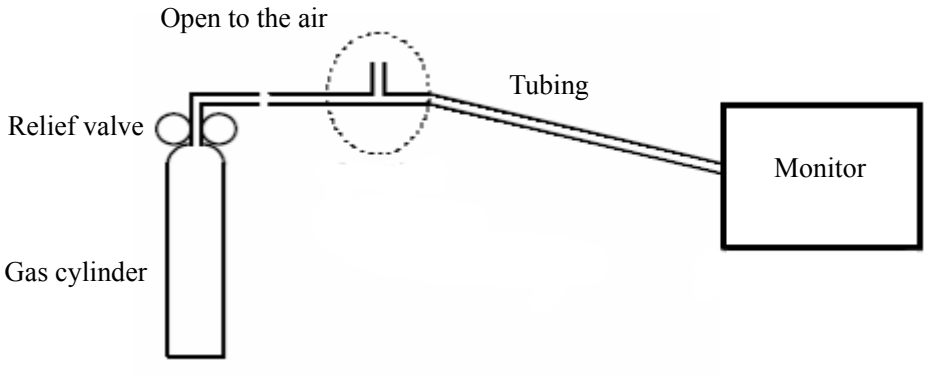
Tools required:

- Gas cylinder, with a certain standard gas or mixture gas. Gas concentration should meet the following requirements: AA≥1.5%, CO_2≥1.5%, N_2O≥40%, O_2≥40%, of which AA represents an anesthetic agent. a/c≤0.01 (a is the gas absolute concentration accuracy; c is the gas concentration）.For 100% O_2 calibration, a gas cylinder with 100% O_2 is used and the O_2 concentration is not less than 99%.
- T-shape connector
- Tubing

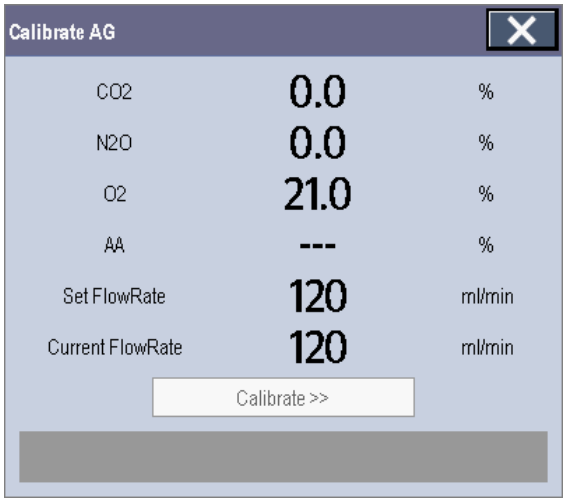
Follow this procedure to perform a calibration:

1. Select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance** >>]→ enter the required password→ [**Calibrate AG >>**].
2. Check the airway and make sure that there are no occlusions or leaks.
   - Vent the sampling tubing to the air and check if the [**Current FlowRate**] and [**Set FlowRate**] are approximately the same. If the deviation is great, it indicates that there is an occlusion in the tubing. Check the tubing for an occlusion.
   - Perform a leakage test to make sure that the airway has no leakage.

Connect the test system as follows:



4. Open the relief valve and vent a certain standard gas or gas mixture and make sure that there is an excess gas flow through the T-shape connector to air.
5. In the [**Calibrate AG**] menu, the concentration and flowrate of each measured gas are displayed.
   - If the difference between the measured gas concentration and the actual one is tolerable, a calibration is not needed.
   - If the difference is great, a calibration should be performed. Select [**Calibrate** >>] to enter the calibrate menu.



6. Enter the vented gas concentration. If you use only one gas for calibration, set other gases' concentration to 0.
7. Select [**Start**] to start a calibration.
8. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. If the calibration failed, the message [**Calibration Failed!**] is displayed. Perform another calibration.

⚠CAUTION

- **Calibrate the O_2 module, If it has been transported for long distance or if you suspect it does not work properly.**

3.2.5 Preventative maintenance test report

Customer name			
Customer address			
Servicing person			
Servicing company			
Equipment under test (EUT)			
Model of EUT			
SN of EUT			
Hardware version			
Software version			
Test equipment	Model/No.	Effective date of calibration	
Test items		**Test records**	**Test results(Pass/Fail)**
Visual inspection			
The case, display screen, buttons, knob, SMR, modules, power cord, wall-mount bracket and accessories have no obvious signs of damage.			
The external connecting cables are not frayed and the connector pins are not loose and bent.			
The external connectors are not loose or their pins are not bent.			
The safety labels and data plate are clearly legible.			
NIBP test			

The difference is within ±3 mm when 0, 50 or 200 mmHg is set for NIBP accuracy test.		
There is no leakage with NIBP, or the manual leakage test result does not exceed 6mmHg/min.		
Sidestream CO_2 test		
Block the gas inlet of the module or watertrap. The sidestream CO_2 flowrate is slower than 10ml/min and an alarm of CO_2 Filterline Err is given. It indicates that there is no leakage.		
The displayed CO_2 value is within 6±0.05%.		
Microstream CO_2 test		
Block the gas inlet of the module or watertrap. An alarm of CO_2 Filterline Err is given. It indicates that there is no leakage.		
The displayed CO_2 value is within 6±0.05%.		
AG test		
When AG flowrate is slower than 10ml/min, an alarm of AG Airway Occluded is given. It indicates that there is no leakage.		
The fan inside the AG module works properly.		
The measurement accuracy of CO_2, N_2O, O_2 and AA (AA represents an anaesthetic agent) meets the product specifications in the Operator's Manual.		

3.3 Power On Test

This test is to verify that the patient monitor can power up correctly. The test is passed if the patient monitor starts up by following this procedure:

1. Insert two batteries in the battery chamber and connect the patient monitor to the AC mains, the AC mains LED and battery LED light.
2. Press the power on/off switch to switch on the patient monitor. The operating status LED lights up, and the technical and physiological alarm lamps light blue and red respectively.
3. After the start-up screens are displayed, the system sounds a beep indicating the self test on alarm sounds is passed. At the same time, the alarm lamp turns from yellow to red, and then turns off together with the technical alarm lamp. This indicates that the self test on alarm lamps is passed.
4. The patient monitor enters the main screen and start-up is finished.

3.4 Module Performance Tests

3.4.1 ECG Tests

ECG Performance Test

Tool required:

- Fluke Medsim 300B patient simulator recommended

Follow this procedure to perform the test:

1. Connect the patient simulator with the ECG module using an ECG cable.
2. Set the patient simulator as follows: ECG sinus rhythm, HR=80 bpm with the amplitude as 1mV.
3. Check the ECG waves are displayed correctly without noise and the displayed HR value is within 80 ± 1 bpm.
4. Disconnect each of the leads in turn and observe the corresponding lead off message displayed on the screen.
5. Set that the simulator outputs paced signals and set [**Paced**] to [**Yes**] on the monitor. Check the pace pulse marks on the monitor screen.

ECG Calibration

Tool required:

- Vernier caliper

Follow this procedure to perform a calibration:

1. Select the ECG parameter window or waveform area→ [**Filter**]→ [**Diagnostic**].
2. Select [**Main Menu**]→ [**Maintenance>>**].
3. Select [**Calibrate ECG**]. A square wave appears on the screen and the message [**ECG Calibrating**] is displayed.
4. Compare the amplitude of the square wave with the wave scale. The difference should be within 5%.
5. After completing the calibration, select [**Stop Calibrating ECG**].

If necessary, you can print out the square wave and wave scale through the recorder and then measure the difference.

3.4.2 Resp Performance Test

Tool required:

- Fluke Medsim 300B patient simulator recommended

Follow this procedure to perform the test:

1. Connect the patient simulator to the module using a non ESU-proof cable and set lead II as the respiration lead.
2. Configure the simulator as follows: lead II as the respiration lead, base impedance line as 1500 Ω; delta impedance as 0.5 Ω, respiration rate as 40 rpm.
3. Check the Resp wave is displayed without any distortion and the displayed Resp value is within 40 ± 2 rpm.

3.4.3 SpO_2 Test

Tool Required:

- None.

Follow this procedure to perform the test:

1. Connect SpO_2 sensor to the SpO_2 connector of the monitor. Set [**Patient Cat.**] to [**Adu**] and [**PR Source**] to SpO_2 on the monitor.
2. Measure SpO_2 on your finger. (Assume that you stay healthy)
3. Check the Pleth wave and PR reading on the screen and make sure that the displayed SpO_2 is within 95%-100%.
3. Remove the SpO_2 sensor from your finger and make sure that an alarm of SpO_2 Sensor Off is triggered.

NOTE

- **A functional tester cannot be used to assess the accuracy of a pulse oximeter monitor. However, it can be used to demonstrate that a particular pulse oximeter monitor reproduces a calibration curve that has been independently demonstrated to fulfill a particular accuracy specification.**

3.4.4 NIBP Tests

See section ***3.2.2 NIBP Tests.***

3.4.5 Temp Test

Tool required:

- Resistance box (with accuracy above 0.1Ω)

Follow this procedure to perform the test:

1. Connect the two pins of any Temp connector of a module to the two ends of the resistance box using 2 wires.
2. Set the resistance box to 1354.9Ω (corresponding temperature is 37ºC).
3. Verify each Temp channel of the monitor and make sure that the displayed value is within 37 ± 0.1ºC.

You can also use a patient simulator to perform the Temp test.

3.4.6 IBP Tests

IBP Performance Test

Tool required:

- Medsim300B patient simulator, MPS450, or other equivalent device
- Dedicated IBP adapter cable (300B, P/N 00-002199-00) (use P/N 00-002198-00, if the simulator is MPS450)

Follow this procedure to perform the test:

1. Connect the patient simulator with the pressure module.
2. Make the patient simulator outputs 0 to each IBP channel.
3. Press the Zero Key on the module to make a zero calibration.
4. Configure the patient simulator as P (static) = 200 mmHg.
5. The displayed value should be within 200 ± 2 mmHg.
6. If the value is outside of these tolerances, calibrate the pressure module. If the IBP module was calibrated with a dedicated reusable IBP sensor, check the calibration together with this IBP sensor.
7. Make that the patient simulator outputs 120/80 mmHg ART signals and 120/0 mmHg LV signals respectively to each IBP channel and check that the IBP wave is displayed correctly.

8 Repeat the steps above for all the IBP channels.

IBP Pressure Calibration

Method 1:
Tools required:

- Medsim300B Patient simulator, MPS450, or other equivalent device
- Dedicated IBP adapter cable (300B, P/N 00-002199-00) (use P/N 00-002198-00, if the simulator is MPS450)

Follow this procedure to perform the test:

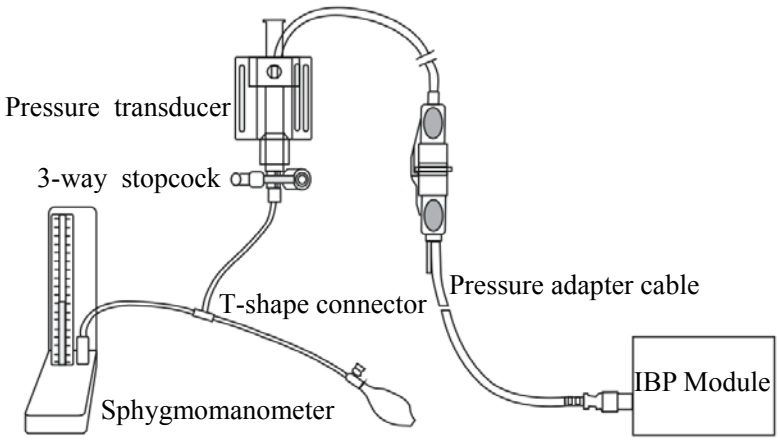
1. Connect the patient simulator to the pressure connector on the module.
2. Set the patient simulator to 0 pressure for the desired IBP channel.
3. Press the Zero Key on the module to make a zero calibration.
4. Configure the patient simulator as P (static) = 200 mmHg.
5. Select [**Main Menu**]→ [**Maintenance >>**]→[**User Maintenance >>**] →[**Cal**. **IBP Press. >>**]. In the [**Cal. IBP Press.**] menu, set the calibration value to 200 mmHg.
6. Select the [**Calibrate**] button next to the desired IBP channel to start a calibration.
7. If the calibration is completed successfully, the message [**Calibration Completed!**] will be displayed. Otherwise, a corresponding message will be displayed.

Method 2:
Tools required:

- Standard sphygmomanometer
- Balloon pump
- Tubing
- T-shape connector

To perform a calibration:

1. Connect the 3-way stopcock, the sphygmomanometer and the balloon pump through a T-shape connector, as shown below.
2. Zero the transducer. Then open the stopcock to the sphygmomanometer.
3. Press the Main menu button on the equipment's front panel. Select [**Maintenance>>**]→ [**User Maintenance >>**]→ enter the required password→[**Cal**. **IBP Press. >>**]. Then configure IBP calibration value.
4. Inflate using the balloon pump until the reading of sphygmomanometer approximates the preset calibration value.



5. Adjust the calibration value in the [**Cal. IBP Press.**] menu until it is equal to the reading of sphygmomanometer
6. Select the [**Calibrate**] button to start a calibration
7. The message [**Calibration Completed!**] is displayed after a successful calibration. If the calibration failed, the prompt [**Calibration Failed!**] will be displayed.

3.4.7 C.O. Test

Tools required:

- Medsim300B Patient simulator
- C.O. adapter box

Follow this procedure to perform the test:

1. Connect the patient simulator to the C.O. module using a C.O. main cable.
2. Set the blood temperature (BT) to 37ºC on the patient simulator and check the temperature value is 37 ± 0.1ºC.
3. Set [**Auto IT**] to [**Off**] and adjust [**IT**] to 24ºC. Select [**C.O. Measure**] to enter the C.O. measurement window and set [**Comp. Const.**] to 0.595.
4. Set the injectate temperature to 24ºC and the C.O. to 5L/min on the C.O. simulator. Select [**Start**] in the C.O. measurement window to start C.O. measurements and after 3-10 seconds press the run key on the simulator.
5. Check the C.O. value is 5±0.25L/min.

3.4.8 Mainstream CO_2 Tests

NOTE

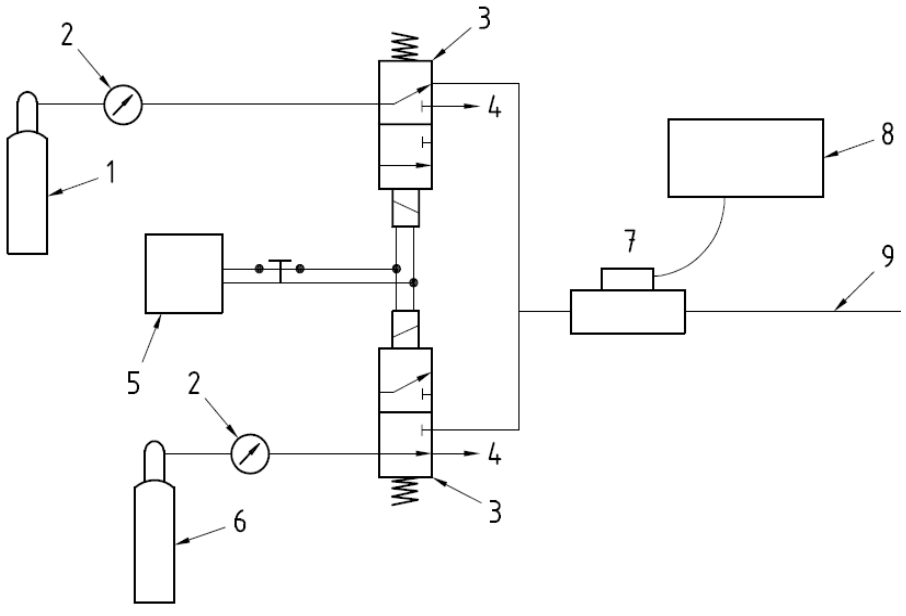
- **Make sure that the barometric pressure set in [Maintain CO_2] of [User Maintenance] accords with the local barometric pressure before performing mainstream CO_2 tests.**

Tools required:

- A steel gas cylinder with 6±0.05% CO_2
- A steel gas cylinder with compressed air or N_2 (with standard concentration)
- Two 3-way valves (power supply controlled)
- Flowmeter
- Power supply
- Tube

Follow this procedure to perform the test:

1. Wait until CO_2 warmup is finished and then select [**Start Zero Cal.**]from [**CO_2 Setup**] menu to start a zero calibration. If the zero calibration fails, the prompt message [**CO_2 Zero Failed**] is displayed. Otherwise, the baseline of waveform recovers to zero.
2. Set [**Apnea Time]** to 10 s in the [**Adjust $CO_2$2 Limits**] menu.
3. Blow to the CO_2 sensor to generate a CO_2 waveform and then place the sensor in the air. Check if the alarm message [**CO_2 Apnea]** is displayed on the screen.
4. Connect the test system as follows



Indication of numbers in the figure above

1 A steel gas cylinder with 6±0.05% CO_2

2 Flowmeter

3 3-way valve (power supply controlled)

4 Open to air

5 Power supply (controlling two 3-way valves)

6 Compressed air or N_2 with standard concentration

7 Mainstream CO_2 sensor

8 Patient monitor

9 Tube (preventing back flow)

5 Adjust the power supply and turn on/off 3-way valves to ensure that that only one cylinder is connected to Mainstream CO_2 sensor via 3-way valves at one time and the flowmeter reading is stable and within 2-5L/min.

6 Switch between the two cylinders to connect Mainstream CO_2 sensor at intervals of 6 -10s and check if the displayed CO_2 value is within 6±0.05%.

3.4.9 Sidestream and Microstream CO_2 Module Tests

See section 3.2.3 Sidestream and Microstream CO_2 Module Tests.

3.4.10 AG Tests

See section ***3.2.4 AG Tests.***

3.4.11 ICG Test

Tool required:

- ICG simulator (BZ-4575)

1. Connect the ICG simulator and the patient monitor using standard ICG cable and sensor.
2. Select **[ICG setup]**→ [**Patient Demographics >>**] and then input parameter values as follows:

Height	180 cm	CVP	6 mmHg
Weight	75 kg	PAmean	8 mmHg
PAWP	10 mmHg		

3. Switch on the simulator and set as follows: HR=60±1 bpm, VI=61±4/1000s, TFC=32±2/kOhms. Then, start ICG monitoring.
4. After the measurement becomes stable and check that the measured results are as follows: HR=60±2 bpm, VI=61±4/1000s, TFC=32±2/kOhms.
5. Set on the simulator as follows: HR=70±1 bpm, VI=48±4 /1000s, TFC=32±2 / kOhms, and then start ICG monitoring. After the measurement becomes stable and check that the measured results are as follows: HR=70±2 bpm, VI=48±4 /1000s, TFC=32±2 / kOhms.

3.4.12 BIS Test

You can choose either of the following methods to perform the test:

Method 1:

Tools required:

- None.

1. Connect the BIS sensor to a healthy, wide-awake adult as directed in the Operator's Manual.
2. Check the EEG wave and BIS numerics displayed on the screen and make sure the BIS value is within 80-100.

Method 2:

Tools required:

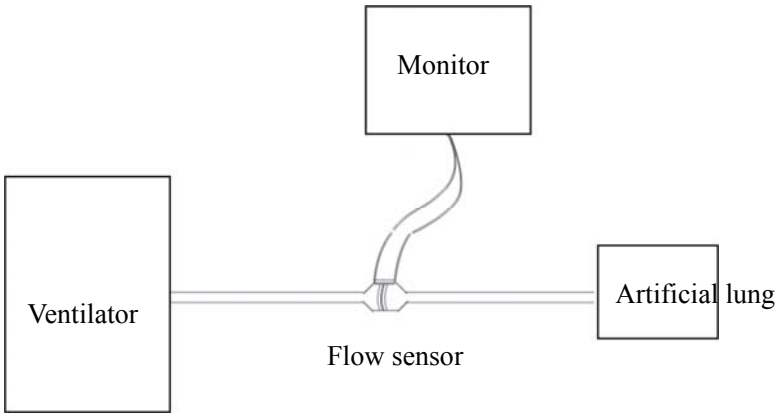
- BIS simulator (with flexible cable)

1. Connect the BIS sensor with the BIS simulator and select [**BIS Setup**]→ [BIS Sensor Check] to perform a cyclic impedance check.
2. After the cyclic impedance check is finished, check that the result for each electrode is pass.
3. Check the EEG wave and BIS numeric displayed on the screen.

3.4.13 RM Test

Tool required:

- Gas source
- Ventilator (calibrated)
- Artificial lung
- Pediatric/neonate flow sensor



Follow this procedure to perform the test:

1. Connect the equipment as shown above. Make sure that the blue sensing tube on the flow sensor is connected with the artificial lung.
2. Set [**Patient Cat.**] to [**Adu**]. In the [**RM Setup**] menu, select [**Sensor Type**] according to the used sensor and set [**Ventilation Mode**] to [**Mechanical**].
3. Enter the [**RM Setup**] menu and select [**Calibrate** >>]. Input the constant marked on the sensor and calibrate the flow sensor.
4. Configure the ventilator as follows: TV=500 ml, RR =20 rpm, I:E=1:2.
5. Select [**Respiratory Loop**] in the [**RM Setup**] menu. Verify that the displayed TV is within 500±50ml and RR is within 20±1rpm.

3.4.14 CCO/SvO_2 Tests

Interconnecting Function

Tools required:

- None.

1. Connect and set the patient monitor and Vigilance monitor per the procedures in the Operator's Manual.
2. Set the Vigilance monitor to Demo mode.
3. Check that the CCO/SvO_2 numerics displayed on the patient monitor and Vigilance monitor are consistent.

Output Performance

Tools required:

- Oscillograph

1. Connect the signal output end of the connecting cables of the CCO/SvO_2 module to the oscillograph.
2. Make the monitor to perform an ECG calibration. Check that the ECG waves displayed on the oscillograph are consistent with the ECG calibration waves displayed on the monitor screen.
3. Select [**CCO Setup**]→ [**Signal Output Setup >>**] and then select [**Simulated High Value**] from the pop-up menu. Check that the amplitude of electrical level at the signal output port of MAP, CVP and SpO_2 are 5±0.25V, 5±0.25V and 10±0.5V respectively.

3.4.15 PiCCO Tests

You can perform PiCCO test by either of the following two methods:

Method 1:
Tools required:

- Patient simulator: Medsim300B
- Pulsion Calbox
- PiCCO IBP test cable

1. Connect the PiCCO cable to the PiCCO module and the Pulsion Calbox respectively.
2. Connect the PiCCO IBP test cable to the PiCCO module and the patient simulator respectively.
3. Adjust the knob on the Pulsion Calbox. Check that the detected catheter type accords with the setup of the Pulsion Calbox, and the measurement errors of TB and TI are within ±0.1℃.

Method 2:
Tools required:

- Patient simulator: Medsim300B
- C.O. adapting box (used for connecting Medsim300B)
- PiCCO C.O. test cable (6800-J88)
- PiCCO IBP test cable (6800-J87)

1. Connect PiCCO C.O. test cable, PiCCO module, patient simulator and C.O. adapting box.
2. Set the blood temperature of the simulator to 37℃. Check that the displayed blood temperature value of the patient monitor is within (37±0.1)℃.
3. Check that the catheter type is “PV2015L20”.
4. Set the injectate temperature to 10℃ and C.O. value to 2.5L/min in the patient simulator. Select [**Start**] in the [**PiCCO Measurement**] window to start the C.O. measurement. Lower the injectate temperature of the patient simulator to about 4℃, then start up the patient simulator.
5. Check that the patient monitor displays the C.O. measurement correctly.

When performing PiCCO test with the above two methods, please see ***3.4.6 IBP Tests*** for pArt and pCVP performance test and pressure calibration, and remember to set the pCVP waveform from the patient simulator to [**CVP**].

3.4.16 $ScvO_2$ Tests

You can perform $ScvO_2$ test by either of the following two methods:

Method 1:
Tools required:

- PC (installed OM_Simulation software, G-6800-S15)
- $ScvO_2$ test cable (6800-J68)

1. Connect the $ScvO_2$ test cable to the $ScvO_2$ module and the serial port on the PC respectively;
2. Open $ScvO_2$ test software to select the corresponding serial port from [**COM port**] menu (default serial port: COM1);
3. Select [**Start**] from the [**Replay**] menu. Then the $ScvO_2$ measurement area is displayed on the patient monitor;
4. Enter [**$ScvO_2$ Setup**] menu and set [**Hb/Hct**] to [**Hct**];
5. Set [**LED660**], [**LED800**], [**LED880**] to '1250，40000' (inching with the direction key on the keyboard if needed). Select [**Start**] from the [**Replay**] menu;
6. Enter [**$ScvO_2$ Calibration**] menu and select [**Sample drawn**] when SQI occupies four grids (80%). In the popup menu, set [**$ScvO_2$**] and [**Hct**] to 67％ and 40％ respectively, then select [**Calibrate**]. Close [**$ScvO_2$ Calibration**] menu to check that the $ScvO_2$ value is displayed as 67％ in the monitoring screen.
7. Set the value of [**LED660**] to '1250, 33600' and keep other LCD values unchanged. Check that the $ScvO_2$ measurement is within (50±3)%.
8. Set the value of [**LED660**] to '1250, 46400' and keep other LCD values unchanged. Check that the $ScvO_2$ measurement is within (80±3)%.

Method 1:
Tools required:

- None.

1. Connect the $ScvO_2$ sensor to the patient monitor. Check that the front end of the $ScvO_2$ sensor illuminates normally.
2. Nip the front end of the $ScvO_2$ sensor with two fingers to perform a $ScvO_2$ calibration.
3. Check that the patient monitor displays the $ScvO_2$ measurement normally.

3.5 Nurse Call Relay Performance Test

Tools required:

- Multimeter

1. Connect the nurse call cable to the Nurse Call Connector of the patient monitor.
2. Enter Demo mode. Then, select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance >>**]→ enter the required password→ [**Others >>**]→ [**Auxiliary Output**]→ [**Nurse Call].**
3. In the [**Others >>**] menu, select [**Nurse Call Setup >>**] and then select all options of [**Alm Lev**] and [**Alarm Cat.**] and set **[Contact Type]** to **[Normally Open]**
4. In [**Nurse Call Setup >>**] setup menu, set [**Signal Type**] to [**Pulse**]. Make the monitor to generate an alarm and check that the output are pulses of 1s width and the relay contacts are close (can be measured with a multimeter) when there is an alarm.
5. In [**Nurse Call Setup >>**] setup menu, set [**Signal Type**] to [**Continuous**].Make the monitor to generate an alarm and check that the output is continuous high level and the relay contacts are close (can be measured with a multimeter) when there is an alarm.

3.6 Analog Output Performance Test

Tool required:

- Patient simulator
- Oscillograph

1. Connect the patient simulator to the monitor using an ECG or IBP cable and connect the oscillograph to the Auxiliary Output Connector of the patient monitor.
2. Select [**Main Menu**] → [**Analog Output Setup].** Switch Analog Output [On].
3. Verify that the waves displayed on the oscillograph are identical with those displayed on the monitor.

3.7 Electrical Safety Test

See ***A Electrical Safety Inspection*** for electrical safety tests.

3.8 Touchscreen Calibration

Tools required:

- None.

1. Select the [**Cal. Screen**] QuickKey or select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance >>**]→ enter the required password→ [**Cal. Touchscreen**].
2. The symbol will appear at different positions of the screen.
3. Select, in turn, the central point of the symbol.
4. After the calibration is completed, the message [**Screen Calibration Completed!**] is displayed. Select [**Ok**] to confirm the completion of the calibration.

3.9 Recorder Check

Tools required:

- None.

1. Print ECG waveforms. The recorder should print correctly and the printout should be clear.
2. Set the recorder to some problems such as out of paper, etc. the patient monitor should give corresponding prompt messages. After the problem is removed, the recorder should be able to work correctly.
3. Switch automatic alarm recording for each parameter ON and then set each parameter's limit outside set alarm limits. Corresponding alarm recordings should be triggered when parameter alarms occur.

3.10 Network Print Test

Note

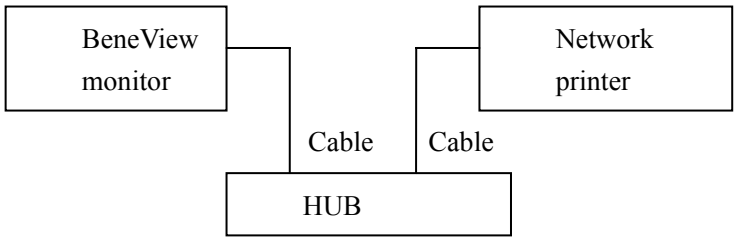
- **HP LaserJet 1505n, P2035n, P4015n, or 1606dn laser printer is recommended for BeneView series of patient monitors.**

Tools required:

- Hub and network cable

3.10.1 Equipment Connection and Setup

1 Connect the patient monitor and network printer to a HUB using common network cables as follows:



2 Set IP address as follows: Select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance >>**]→ enter the required password→ [**IP Address Setup >>**] and set the IP address of the patient monitor in the same network segment with that of the network printer. (See the instructions for use accompanying the printer)

3 Search for printer by selecting [**Main Menu**]→ [**Print Setup >>**]→ [**Printer Setup >>**]→ [**Search Printer**]. After a while, the printer's model and IP address will appear in the box beside [**Printer**].

3.10.2 Print Function Test

1 Enter the Demo mode of the patient monitor.

2 Select [**Main Menu**]→ [**Print Setup >>**]→ [**Realtime Reports >>**]→ [**Normal Report**] and then select [**Print**]. The network printer shall print out the report correctly.

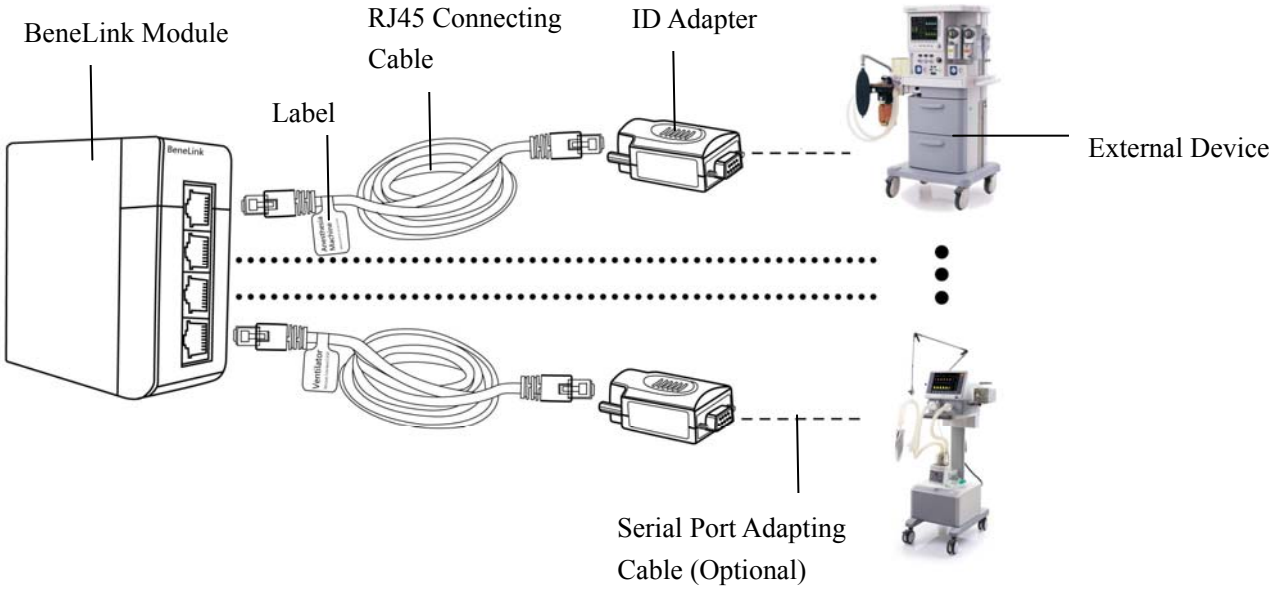
3.11 BeneLink Module Check

3.11.1 Device Connection and Setup

Tools required:

- External device (anesthesia machine, ventilator)
- ID adapter that maches the external device
- RJ45 connecting cable
- Serial port adapting cable that maching the external device

Please refer to the following procedure to connect an external device:



1. Insert the BeneLink module into the module slot on the BeneView patient monitor.
2. Connect the ID adapter that matches the external device to the BeneLink module with a RJ45 connecting cable.
3. Plug the ID adapter into the RS232 port on the external device. Some external devices may have ports incompatible with the ID adapter. In this case, a serial port adapting cable is required. Please be sure that you have selected the proper cable before connection.
4. Stick a label indicating device name to the RJ45 connecting cable at the end nearby the BeneLink module. When the BeneLink module is connected to several external devices, you can tell the devices apart easily with these labels.
5. Switch the external device on.

NOTE

- **Devices of the same category can not be connected to the BeneLink module simultaneously.**
- **Use the serial port adapting cable only with its matching extermal device. Please see the following table to select the correct adapting cable.**
- **Use the ID adapter only with the matching external device. Please see the following table for correct ID setup in [Factory Maintenance] menu.**

External Device	**ID for ID adapter**	**Type of Serial Port Adapting Cable**
Mindray Wato 20/30/55/65	4D52B2AE	No need to use the adapting cable: the ID adapter can be plugged into the serial port of the external device directly.
Newport E360	4E50B1B0	Type B
Puritan Bennett 840	SNDF：5042AFBE（recommended） SNDA：5031AFCF（support less parameters than protocol SNDF）	No need to use the adapting cable: the ID adapter can be plugged into the serial port of the external device directly.
Maquet Flow-i	4D46B2BA	Type B
Maquet Servo-i/Servo-s	4D53B2AD	Type B
Draeger Evita 2 / Evita 2 dura / Evita 4/ Evita XL	4434BBCC	Type B
Expand Model	/	Type A

3.11.2 Device Integration Function Test

3.11.2.1 Preparation

Prepare the tools needed for function test according to the type of the external device you install. Please see the Instructions for Use of the corresponding external device for guidance. For the function test of ventilator and anesthesia machine, at least the following tools are needed:

- BeneView patient monitor with BeneLink module properly installed
- External device (anesthesia machine or ventilator) under test
- Gas source(tube or gas cylindar), including air or O_2 at least, and N_2O or other anesthesia gases are optional
- Tube that connects the patient(or test lung)
- Test lung and a matching Y-pipe, or other accessories

3.11.2.2 Procedure and Items to Be Checked

Follow the steps below:

1. Connect the BeneLink module to the ventilatior or the anesthesia machine. Plaese see ***Device Connection and Setup*** for more details.
2. Connect the gas supply and test lungs to the ventilator or anesthesia machine, turn on the device, and configure as follows:
   - Setup up the serial port of the external device by refering to ***Serial Port Configuraion List***.
   - Setup up the pressure control mode and check if the ventilator or anesthesia machine works normally.
3. Check the ID adapter is correctly configured, and the green indicator of corresponding port on the BeneLink module illuminates constantly.
4. Access [**Devices Integrated**] screen on the patient monitor. Check that the device type (ventilator or anesthesia machine) and ventilation mode are correctly displayed.
5. Select parameters PEEP, Pmean, VTe, MV, I:E, and f(RR) respectively on the patient monitor and check if the parameter values displayed on the patient monitor are consistent with those displayed on the ventilator or anesthesia machine.
6. Re-configure the above parameters on the ventilatior or the anesthesia machine and check if the parameter values displayed on the patient monitor change accordingly.
7. Trigger alarms [**MV Too Low**], [**Airway Pressure Too High**], [**PAW Too High**], [**Peak Too High**], and [**No Gas Supply**] (no Air or O_2) on the ventilatior or the anesthesia machine. Check that these alarm messages are correctly recorded in the alarm list of the patient monitor.

8. Switch the ventilator or anesthesia machine to volume control ventilation mode. Check if the ventilation mode displayed on the patient monitor changes accordingly, and if the parameter values of PEEP, Pmean, VTe, MV, I:E, and f(RR) are correctly displayed.

Serial Port Configuration List

External Device	**Setup**	**Remark**
Mindray Wato 20/30/55/65	Not required.	If you need to view the parameters of CO2、AG、BIS module in the anesthesia machine, select [**Factory Mainenance**] → [**Function Configuration**] → **[Select Module**] in standby mode and tick the corresponding module.
Maquet Servo-i Maquet Servo-s	Not required.	The following information is for further reference: Baud Rate: 9600bps Word Length: 8bits Parity: even Stop Bits: 1
Draeger Evita 2	Channel A: Not required; Channel B: Protocol: Medibus Baud rate: 19200 Parity: even Stop Bits: 1	/
Draeger Evita 2 dura/ Evita 4/ Evita XL	Protocol: Medibus Baud Rate: 19200 Parity: even Stop Bits: 1 Interval: ---(Evita 2 dura)	/
Newport E360	Protocol: Newport	The following information is for further reference: Baud Rate: 38400bps Word Length: 8bits Parity: NONE Stop Bits: 1
Puritan Bennett 840	Baud Rate: 38400 Word Length: 8 bits Parity: NONE	/

3.11.3 Installation and Test Report

Basic Information			
Hospital		Department	
Serial number of ID adapter		Name of the external device	
ID of the external device		Type of serial port adapting cable	
Software version and other information of the external device			

Checking the connection	**Test Result（Yes/No）**
Can the patient monitor and the external device be assembled together using designated accessories?	
Does the green indicator of corresponding port on the BeneLink module illuminate while the other indicators are not?	
Are there numerics or characters displayed on the [**Devices Integrated**] screen of the patient monitor?	
Are the device type and parameter values displayed correctly on the [**Devices Integrated**] screen of the patient monitor when the external device just enters working mode?	
Is the ventilation mode correctly displayed on the patient monitor? Does it change correctly when the ventilation mode on the external device is changed?	

Checking the parameters			
Parameters on the external device	**Value**	**Parameters on the patient monitor**	**Value**
PEEP		PEEP	
Pmean		Pmean	
VTe		VTe	
MV		MV	
I:E		I:E	
f (RR)		f (RR)	

Checking the alarms		
Alarm	**Alarm messages displayed on the external device**	**Alarm messages displayed in the alarm list of the patient monitor**
MV Too Low		
Airway Pressure Too High		

No Gas Supply		
Other information		

3.12 Battery Check

Tools required:

- None.

Function Test

1. If the patient monitor is installed with batteries, remove the batteries first.
2. Verify that the patient monitor works correctly when running powered form an AC source.
3. Insert two batteries per the procedures provided in the Operator's Manual.
4. Remove the AC power cord and verify that the patient monitor still works correctly.
5. For T5 only: Remove one battery and verify that the patient monitor continues to work correctly. Verify that the patient monitor can also work independently from another battery.

Performance Test

Perform the test by referring to the ***Battery*** chapter in the Operator's Manual and verify the operating time of the battery meets the product specification.

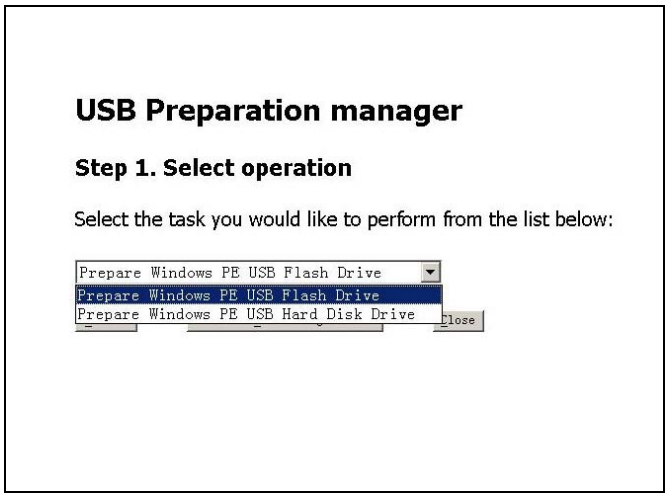
3.13 Imbedded PC System Maintenance

3.13.1 Making USB Startup Disk

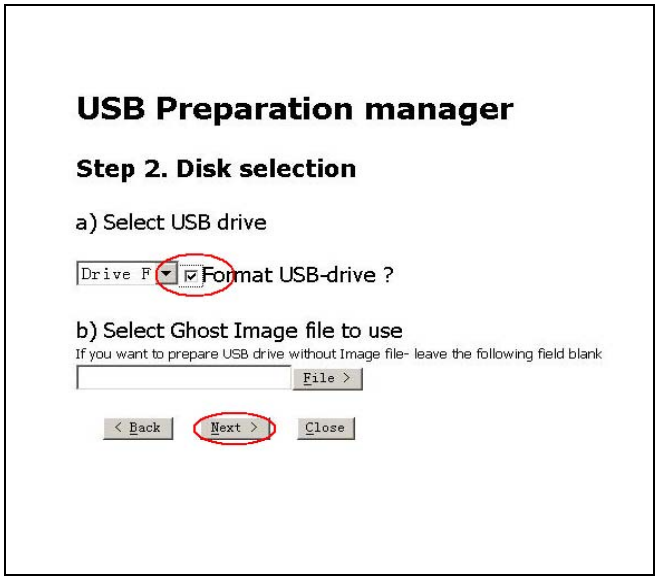
Tools required:

- MakeUSB (PN: 110-002149-00)
- USB drive with capacity greater than 4G.

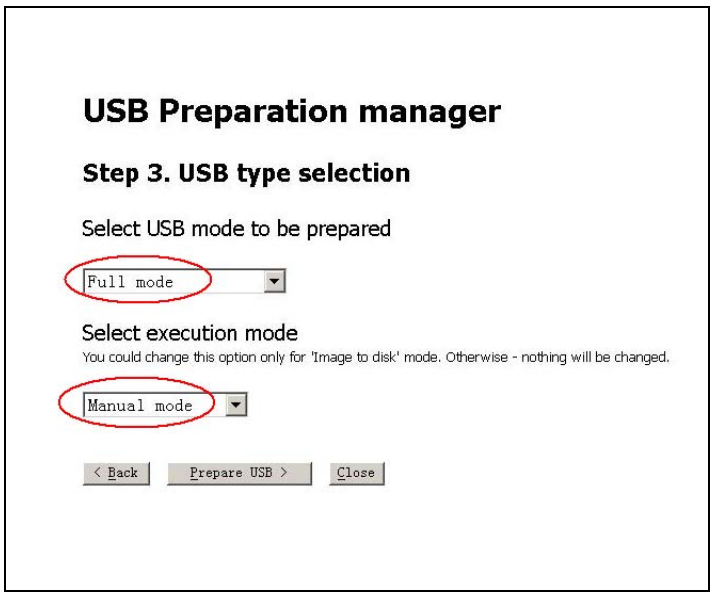
1. Insert the USB drive into PC.
2. Run “prepareUSB.hta” file in the folder of MakeUSB.
3. Select [**Prepare Windows PE USB Flash Drive**] in the drop-down list, and select [**Next>**].


USB Preparation manager
Step 1. Select operation
Select the task you would like to perform from the list below:
Prepare Windows PE USB Flash Drive
Prepare Windows PE USB Flash Drive
Prepare Windows PE USB Hard Disk Drive

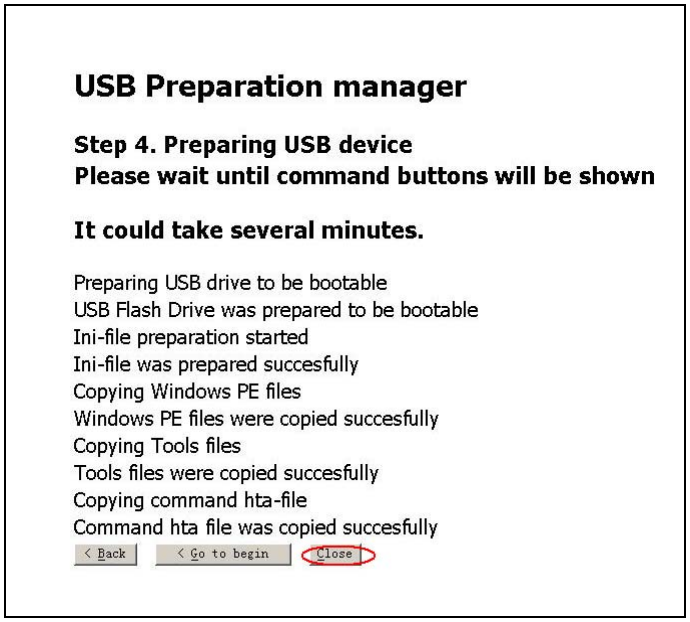
4. Select the drive label of the USB drive in the drop-down list, and configure [**Format USB-drive？**]. [**Select Ghost Image file to use**] is unselected by default. Then select [**Next>**].


USB Preparation manager
Step 2. Disk selection
a) Select USB drive
Drive F
Format USB-drive ?
b) Select Ghost Image file to use
If you want to prepare USB drive without Image file- leave the following field blank
File >
< Back
Next >
Close

5. Select [**Prepare USB>**] to start making the startup disk. The system selects [**Full mode**] and [**Manual mode**] by default.


USB Preparation manager
Step 3. USB type selection
Select USB mode to be prepared
Full mode
Select execution mode
You could change this option only for 'Image to disk' mode. Otherwise - nothing will be changed.
Manual mode
< Back
Prepare USB >
Close

6. Select [**Close**] to finish.


USB Preparation manager
Step 4. Preparing USB device
Please wait until command buttons will be shown
It could take several minutes.
Preparing USB drive to be bootable
USB Flash Drive was prepared to be bootable
Ini-file preparation started
Ini-file was prepared succesfully
Copying Windows PE files
Windows PE files were copied succesfully
Copying Tools files
Tools files were copied succesfully
Copying command hta-file
Command hta file was copied succesfully
< Back
< Go to begin
Close

3.13.2 Restoring the System

Connecting the External USB Cable

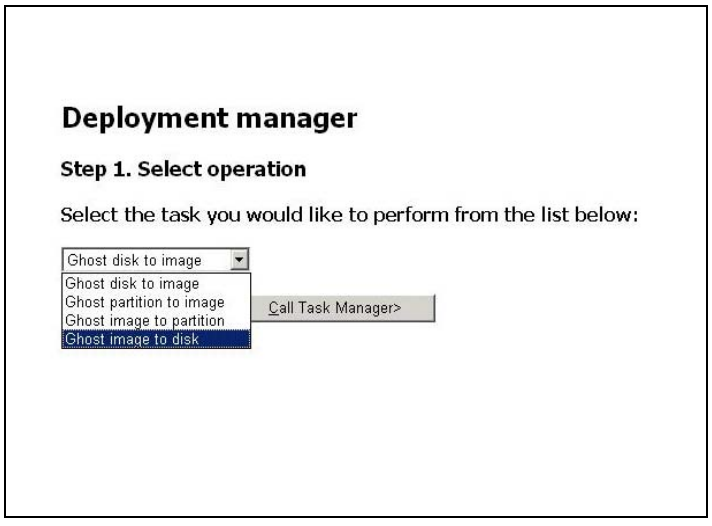
1. Remove the recorder by referring to chapter ***Removing the Recorder***.
2. Two internal USB cables used for maintenance (PN: 6800-20-50818) appears in the place where the recorder lies. Connect two external USB cables used for maintenance (PN: 6800-20-51130) to the two internal USB cables.
3. Connect the USB startup drive containing the system image file (PN: 110-002148-00) to the external USB cable. Do not use the USB connectors on the rear of the monitor.

Setting BIOS Screen

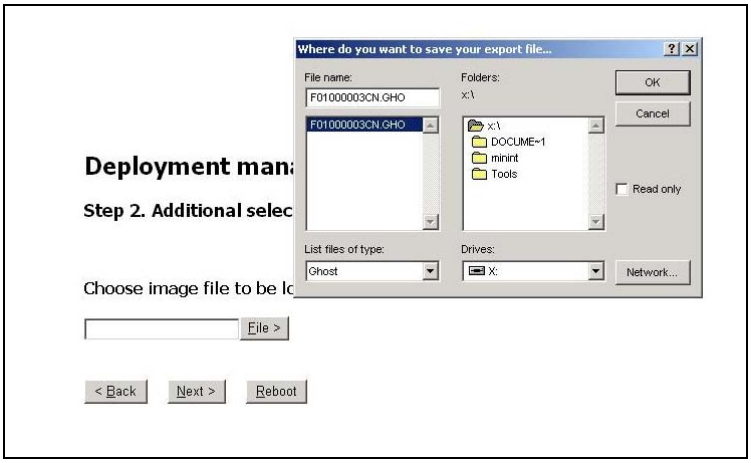
1. Start up the patient monitor and press [**Del**] key repeatedly on the keyboard until the monitor enters normal screen.
2. Select [**Main Menu**] → [**Maintenance>>**] → [**User Maintenance>>**] → enter the required password → [**CIS Maintenance**], and the system switches to BIOS setup screen.
3. Move the cursor to [**Advanced BIOS Features**] by pressing [↑] or [↓] keys on the keyboard. Then press [**Enter**].
4. Move the cursor to [**First Boot Device**], and press [**Enter**] on the keyboard.
5. Select [**USB-HDD**] and press [**Enter**] on the keyboard.
6. Press [**F10**] and then [**Y**] on the keyboard. Save the setup and exit the BIOS setup screen.

Restoring the system

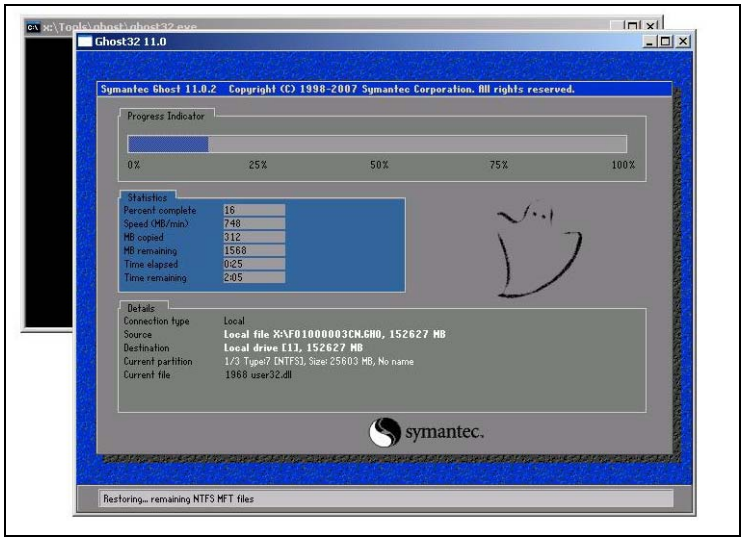
1. Startup the patient monitor with the USB startup drive. The system enters recovery screen.
2. Select [**Ghost image to disk**] in the drop-down list, and then select [**Next>**] to continue.


Deployment manager
Step 1. Select operation
Select the task you would like to perform from the list below:
Ghost disk to image
Ghost disk to image
Ghost partition to image
Ghost image to partition
Ghost image to disk
Call Task Manager>

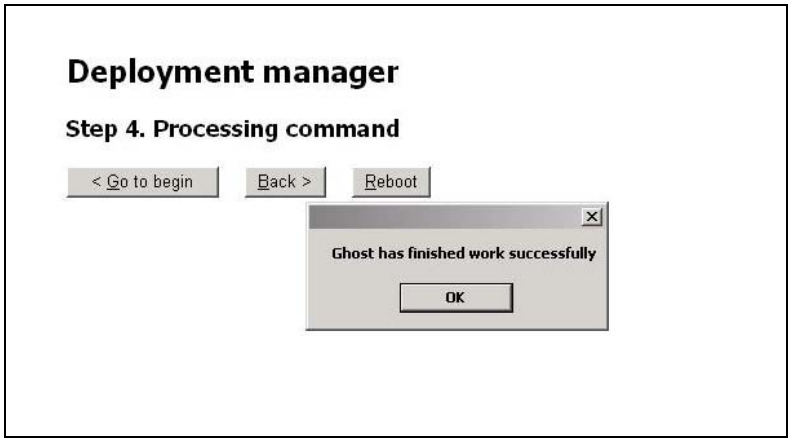
3. Select the path of the image file by clicking [**File>**] button. Then select [**Next>**].



4. Select [**Run>**] to begin restoring the system.



5. Select [**Reboot**] to restart the system and then remove the USB startup drive after restoring the system.



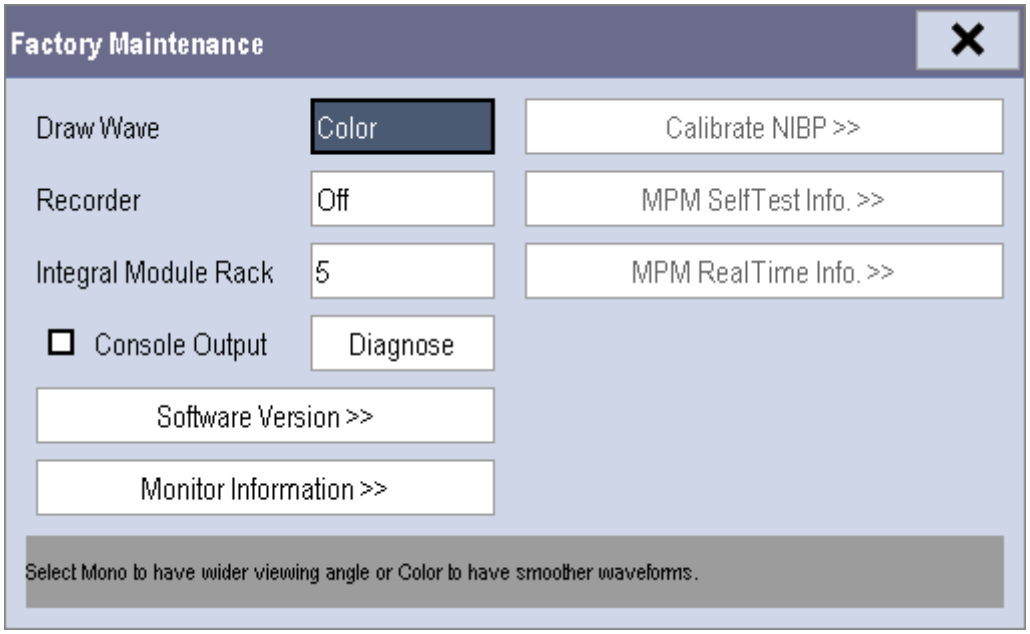
6. Set the patient monitor by referring to Steps 1 to 4 of ***Setting BIOS Screen***. Then set [**First Boot Device**] to [**HDD-0**]. Press [**F10**] and then [**Y**] on the keyboard. Save the setup and exit the BIOS setup screen. The system restarts automatically and enters Windows screen after the setup.

3.14 Factory Maintenance

3.14.1 Accessing Factory Maintenance Menu

To access the factory maintenance menu, select [**Main Menu**]→ [**Maintenance** >>] → [**Factory Maintenance**]and then enter the required password.

The [**Factory Maintenance**] menu is shown below.



3.14.2 Drawing Waves

There are two methods to draw waves: Color and Mono.

- Color: selecting Color will have smoother waveforms.
- Mono: selecting Mono will have a wider viewing angle.

3.14.3 Recorder

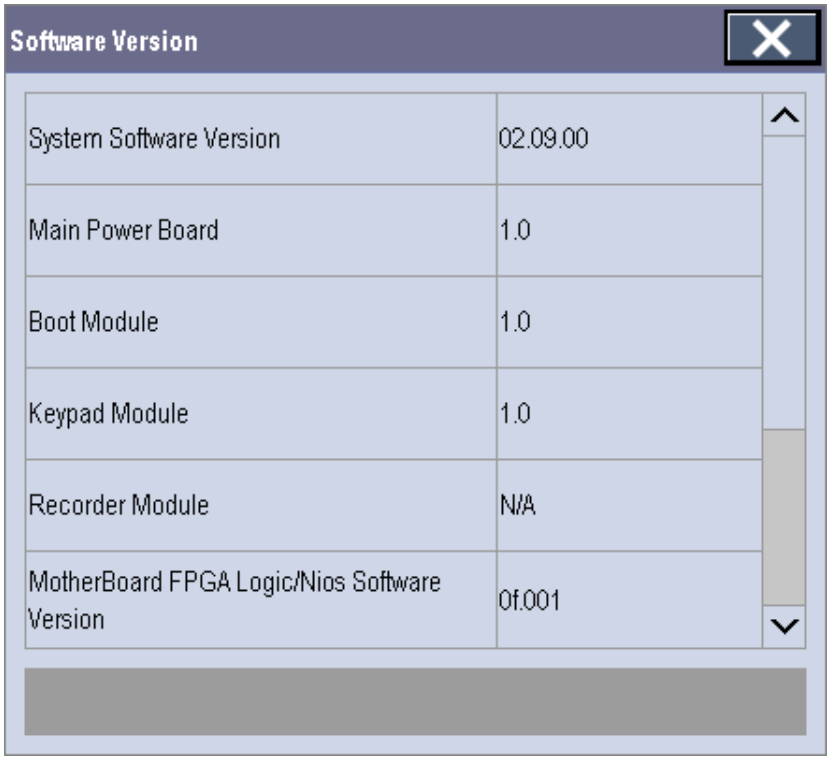
To enable/disable the recorder, select [**Recorder**] and toggle between [**On**] and [**Off**].

⚠CAUTION

- **The recorder is disabled if [Recorder] is switched off in the [Factory Maintenance] menu.**

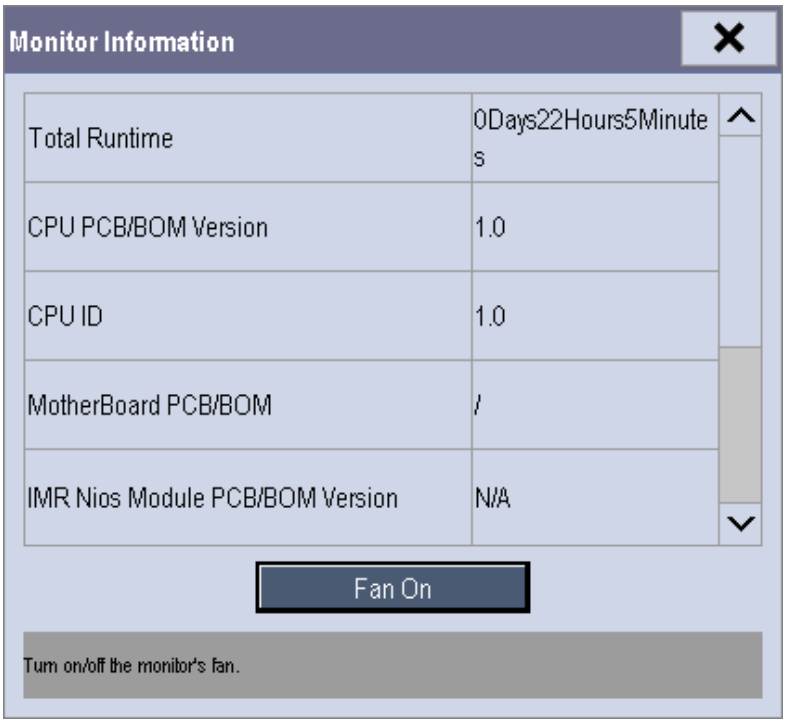
3.14.4 Software Version

Selecting [**Software Version**] will show software version information. The [**Software Version**] menu is as follows:



3.14.5 Monitor Information

Selecting [**Monitor Information**] will show the status of the patient monitor. Monitor information is displayed as follows:



3.14.6 Calibrate NIBP

For details, refer to section ***3.4.4 NIBP Tests.***

Maintenance and Test Report

(See the above sections for detailed test procedures and contents)

Customer name			
Customer address			
Servicing person			
Servicing company			
Equipment under test (EUT)			
Model of EUT			
SN of EUT			
Hardware version			
Software version			
Test equipment	Model/No.	Effective date of calibration	
Test items		Test records	Test results(Pass/Fail)
Visual inspection			
The case, display screen, buttons, knob, SMR, modules, power cord, wall-mount bracket and accessories have no obvious signs of damage.			
The external connecting cables are not frayed and the connector pins are not loose and bent.			
The external connectors are not loose or their pins are not bent.			
The safety labels and data plate are clearly legible.			
Power-on test			
The power-on test is passed. The power indicator and alarm system work correctly and the monitor start up properly.			
Performance test			

ECG performance test		
ECG waves are displayed correctly without noise and the HR value is within 80±1 bpm.		
ECG Lead Off alarm behaves correctly.		
Paced signals are detected and pace pulse marks are displayed when [Paced] is set to [Yes]		
The difference between the amplitude of the ECG calibration square wave and that of the wave scale is not greater than 5%.		
Resp test		
The Resp wave is not distorted and the Resp value is within 40±2 rpm.		
SpO_2 test		
Measure SpO_2 on a healthy person's finger and a Pleth wave and PR value are displayed. The displayed SpO_2 value is within 95%-100%		
NIBP test		
The difference is within ±3 mm when 0, 50 or 200 mmHg is set for NIBP accuracy test.		
There is no leakage with NIBP, or the manual leakage test result does not exceed 6mmHg/min.		
Temp test		
The value displayed for each Temp channel of the monitor is within 37±0.1ºC.		
IBP test		
The static pressure value displayed for each IBP channel is within 200±2 mmHg.		
The ART and LV waves for each IBP channel are displayed correctly.		
C.O. test		
The TB value displayed on the monitor is within 37±0.1ºC.		
The displayed C.O. value is within 5±0.25L/min.		
Mainstream CO_2 test		
The mainstream CO_2 is zeroed successfully and the waveform baseline recovers to zero.		
CO_2 Apnea alarm behaves correctly.		
The displayed CO_2 value is within 6±0.05%.		

Sidestream CO_2 test		
Block the gas inlet of the module or watertrap. The sidestream CO_2 flowrate is slower than 10ml/min and an alarm of CO_2 Filterline Err is given. It indicates that there is no leakage.		
The displayed CO_2 value is within 6±0.05%.		
Miscrostream CO_2 test		
Block the gas inlet of the module or watertrap. An alarm of CO_2 Filterline Err is given. It indicates that there is no leakage.		
The displayed CO_2 value is within 6±0.05%		
AG test		
When AG flowrate is slower than 10ml/min, an alarm of AG Airway Occluded is given. It indicates that there is no leakage.		
The fan inside the AG module works properly.		
The measurement accuracy of CO_2, N_2O, O_2 and AA (AA represents an anaesthetic agent) meets the product specifications in the Operator's Manual.		
ICG test		
The measured results are as follows: HR=60±2 bpm, VI=61±4/1000s, TFC=32±2/kOhms.		
The measured results are as follows: HR=70±2 bpm, VI=48±4 /1000s, TFC=32±2 / kOhms.		
BIS test (you can select either method to perform the test)		
Method 1: The BIS value measured on healthy, wide-awake adult is within 80-100.		
Method 2: Connect to the BIS simulator to perform a cyclic impedance check. The EEG wave and BIS numeric are displayed on the monitor.		
RM test		
The displayed TV is within 500±50ml and RR is within 20±1rpm.		
CCO/SvO_2 test		
The CCO/SvO_2 numerics displayed on the patient monitor and Vigilance monitor are consistent.		
The waves (at the ECG signal output port) displayed on the oscillograph are consistent with the ECG calibration waves displayed on the monitor screen.		

The amplitude of electrical level at the signal output port of MAP, CVP and SpO_2 are 5±0.25V, 5±0.25V and 10±0.5V respectively.		Yes No
PiCCO test		
The detected catheter type accords with the setting of the Pulsion Calbox, and the measurement errors of TB and TI are within ±0.1℃.		
The displayed static pressure values of pArt and pCVP are no more than (200±2) mmHg.		
The waveforms of pArt and pCVP are displayed correctly.		
$ScvO_2$ test		
The accuracy of $ScvO_2$ measurements is (50±3)% and (80±3)%.		
Nurse call relay performance test		
The relay contacts are close when an alarm occurs.		
Analog output performance test		
The waves displayed on the oscillograph are identical with those displayed on the monitor.		
Electrical safety tests		
Refer to ***A Electrical Safety Inspection***. All the electrical safety tests should be passed.		
Touchscreen calibration		
The touchscreen is calibrated successfully.		
Recorder check		
The recorder can print ECG waves correctly and the printout is clear.		
Set the recorder to some problems such as out of paper, paper jam, etc. the monitor gives corresponding prompt messages. After the problem is removed, the recorder is able to work correctly.		
Automatic alarm recording for each parameter functions correctly when parameter alarms occur.		
Network print test		
The network printer can print out ECG reports correctly.		
Device integration check		

[**Devices Integrated**] window can display the type of the external device, ventilation mode, and corresponding parameters normally.		
Battery check		
The monitor can operates correctly from battery power when an AC power failure accidentally occurs.		
T5 patient monitor can operate independently on a single battery.		
The operating time of the battery meets the product specification.		

FOR YOUR NOTES

4 Troubleshooting

4.1 Introduction

In this chapter, patient monitor problems are listed along with possible causes and recommended corrective actions. Refer to the tables to check the patient monitor, identify and eliminate the troubles.

The troubles we list here are frequently arisen difficulties and the actions we recommend can correct most problems, but not all of them. For more information on troubleshooting, contact our Customer Service Department.

4.2 Part Replacement

Printed circuit boards (PCBs), major parts and components in the patient monitor are replaceable. Once you isolate a PCB you suspect defective, follow the instructions in ***5 Repair and Disassembly*** to replace the PCB with a known good one and check that the trouble disappears or the patient monitor passes all performance tests. If the trouble remains, exchange the replacement PCB with the original suspicious PCB and continue troubleshooting as directed in this chapter. Defective PCB can be sent to us for repair.

To obtain information on replacement parts or order them, refer to ***6 Parts.***

4.3 Patient Monitor Status Check

Some troubleshooting tasks may require you to identify the hardware version and status of your patient monitor.

1. To view the information on system start time, self check, etc., select [**Main Menu**]→[**Maintenance >>**]→[**Monitor Information >>**].
2. You can also view the information on the monitor's current status by selecting [**Main Menu**]→[**Maintenance>>**]→[**Factory Maintenance>>**]→enter the required password →[**Monitor Information >>**].

4.4 Software Version Check

Some troubleshooting tasks may require you to identify the configuration and software version of your patient monitor.

1. To view information on the system configuration and system software version, Select [**Main Menu**]→[**Maintenance>>**]→[**Software Version>>**].
2. You can also view the information on system software version and module software version by selecting [**Main Menu**]→[**Maintenance>>**]→[**Factory Maintenance>>**]→ enter the required password →[**Software Version>>**].

4.5 Technical Alarm Check

Before troubleshooting the patient monitor, check for technical alarm message. If an alarm message is presented, eliminate the technical alarm first. For detailed information on technical alarm message, possible cause and corrective action, refer to the patient monitor's Operation Manual.

4.6 Troubleshooting Guide

4.6.1 Power On/Off Failures

Symptoms	Possible Cause	Corrective Action
The patient monitor fails to start. AC LED or battery LED does not light	AC mains not connected or battery too low	Check that AC mains is properly connected or battery capacity is sufficient.
	Power supply protection	Refer to ***4.6.9 Power Supply Failures*** .
	Cables defective or poorly connected	1. Check that the cables from power switch & LED board to button board, button board to main board, and power module to main board are correctly connected. 2. Check that cables and connectors are not damaged.
	Power switch & LED board defective	Replace the power switch & LED board.
	Power module defective	Replace the power module.
	Mother board Defective	Replace the mother board.

4.6.2 Display Failures

Symptoms	Possible Cause	Corrective Action
Integrated display is blank but the patient monitor still works correctly.	Cables defective or poorly connected.	1. Check that cables from the display to the mother board and from the backlight board to the button board/display are correctly connected. 2. Check that the cables and connectors are not damaged.
	Backlight board defective	Replace the backlight board.
	Power module defective	Replace the power module.
	Display defective	Replace the display.
Secondary display does not function.	Cables defective or poorly connected.	1. Check that the cable between the display and the patient monitor is correctly connected. 2. Check that the cables and connectors are not damaged.
	DVI interface board defective	Replace the DVI interface board.
Secondary display displays snows or flashing specks	Cables defective or poorly connected.	1. Check that the cable between the display and the patient monitor is correctly connected. 2. Check that the cables and connectors are not damaged.
	DVI interface board defective	Replace the DVI interface board.
	The mother board is damaged.	Replace the mother board.
Images overlapped or distorted	FPGA error.	Update or upgrade FPGA.
	Cables defective or poorly connected.	1. Check that the cable between the display and mother board is correctly connected. 2. Check that the cables and connectors are not damaged.
Touchscreen does not response	Touchscreen disabled	Check if there is a symbol shown above the [**Main Menu**] QuickKey. If yes, press the [**Main Menu**] QuickKey for more than 3s to enable the touchscreen.

	Cables defective or poorly connected.	1. Check that the cables from the touchscreen to the touchscreen control board, the touchscreen control board to the button board, and the button board to the mother board are correctly connected. 2. Check that the cables and connectors are properly connected
	Touchscreen control board defective	Replace the touchscreen control board
	Button board defective.	Replace the button board.
	Touchscreen defective.	Replace the touchscreen
	Mother board defective	Replace the mother board
Touch position invalid	Touchscreen not calibrated	Calibrate the touchscreen

4.6.3 Module Rack Failures

Symptoms	Possible Cause	Corrective Action
SMR		
SMR cannot identify parameter modules	Extension Cable defective or poorly connected	1. Check that the cable between SMR and main unit is properly connected 2. Check that the connecting cables and connectors are not damaged. 3. Check that contact screws on SMR are tightly screwed and properly contact the SMR.
	Defective parameter module	Replace the suspicious parameter module with a known good module. Check if the patient monitor identifies the replacement module. If yes, it means that the original one is defective.
	Wrong communication board software revision	Upgrade the program of the module or SMR.
	Module (in some slots) unrecognized	1. Replace the Nios II module. 2. Replace the 8-slot module rack communication board.

	Power supply failure	1. Check if the voltage between two contact screws in any slot reaches 12V DC. If yes and the parameter module functions, the PCB assembly in SRM might fail. 2. If there is no 12 V sent to the SMR, check that the power module output voltage to the USB interface board reaches 12V. If yes, the fuse on the USB interface board might blow. Replace the USB interface board.
	Cable defective or poorly connected	1. Check that the cable between SMR interface board and communication board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	Nios II module loose or failure	1. Check that Nios II module is correctly plug ed 2. If the symptom persists, replace the Nios II module.
	SMR interface board failure	Replace the SMR interface board.
	SMR communication board failure	Replace the SMR communication board.
	USB interface board failure	Replace the USB interface board.
	Mother board failure	Replace the mother board.
Integral module rack		
Integral module rack cannot identify parameter modules	Module failure	Replace parameter module. If a new module is identified, the original one is defective.
	Cable defective or poorly connected	1. Check that the cables from 3-slot module rack communication board to MPM module rack communication board, module rack to mother board are properly connected. 2. Check that connecting cables and connectors are not damaged.
	Wrong communication board software revision	Upgrade the program of the module or Integral module rack.
	Module (in some slots) unrecognized	Replace the corresponding module rack communication board.

	Power supply to integral module rack abnormal	1. Check if voltage between two contact screws in any slot reaches 12VDC. If yes and the parameter module functions, PCB assembly in the SMR might fail. 2. If there is no 12V sent to the integrated module rack, check that power module output voltage to mother board reaches 12V DC. If yes, mother board might fail.
	3-slot or MPM module rack communication board failure	Replace the 3-slot or MPM module rack communication board.
	Nios II module failure	Replace the Nios II module.
	Mother board failure	Replace the mother board.

4.6.4 Alarm Problems

Symptoms	**Possible Cause**	**Corrective Action**
The alarm lamp is not light or extinguished but alarm sound is issued	Cable defective or poorly connected	1. Check that cables from alarm LED board to button board and button board to mother board are properly connected. 2. Check that connecting cables and connectors are not damaged.
	Alarm LED board failure	Replace the alarm LED board.
	Button board failure	Replace the button board.
	Mother board failure	Replace the mother board.
No alarm sound is issued but alarm lamp is light	Audio alarm disabled	Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Alarm Setup >>**], and then in the popup menu, set [**Minimum Alarm Volume**] to appropriate setting. In the [**Others**] window of the [**Alarm Setup**] menu, set [**Alm Volume**] to appropriate setting.
	Cable defective or poorly connected	1. Check that cable between speaker and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	FPGA audio logic error	Upgrade the audio logic part of the FPGA program.
	Speaker failure	Replace the speaker.
	Mother board failure	Replace the mother board.

4.6.5 Button and Knob Failures

Symptoms	Possible Cause	Corrective Action
Buttons do not work	Cable defective or poorly connected	1. Check that cable between button board and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	Button board failure	Replace button board.
Knob does not work	Cable defective or poorly connected	1. Check that cables from knob to button board, and button board to mother board are properly connected 2. Check that connecting cables and connectors are undamaged.
	Knob failure	Replace the knob encoder.
	Button board failure	Replace the button board

4.6.6 Recorder Failures

Symptoms	Possible Cause	Corrective Action
No printout	Recorder module disabled	1. Check if the recorder status LED lights 2. If yes, enable the module in [**Factory Maintenance**] menu. Otherwise, check for other possible causes.
	Paper reversed	Re-install the paper roll.
	Cable defective or poorly connected	1. Check that cable between recorder and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	Recorder power supply failure	Check if the power module outputs 5 V DC and 12V DC correctly.
	Recorder failure	Replace the recorder.
Poor print quality or paper not feeding properly	Paper roll not properly installed	Stop the recorder and re-install the paper roll.
	Print head dirty	1. Check the thermal print head and the paper roller for foreign matter. 2. Clean the thermal print head with an appropriate clean solution.
	Print head failure	Replace the print head.
	Recorder failure	Replace recorder.

4.6.7 Interface Failures

Symptoms	Possible Cause	Corrective Action
No analog signals or nurse call signals are issued	Respective output disabled	1. Select [**Main Menu**]→[**Analog Output Setup**]→set [**Analog Output**] to [**On**].
	DVI interface board cable loose	1. Check that cable between DVI interface board and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	DVI interface board failure	Replace the DVI interface board.
	Mother board failure	Replace the mother board.
Device with USB port does not function (Assume that the peripheral devices are good)	Cable defective or poorly connected	1. Check that cable between USB interface board and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	USB interface board failure	Replace the USB interface board.
	Mother board failure	Replace the mother board.

4.6.8 CF Card Problems

Symptoms	Possible Cause	Corrective Action
CF card malfunctions	Wrong CF card or small memory space	Use only SanDisk-manufactured CF storage cards. Those with 4GB memory space are recommended.
	CF card full; data error; CF card error	Format CF card on PC.
	CF card failure	Replace the CF card.
	Cable defective or poorly connected	1. Check that the cable between CF card board and mother board is correctly connected. 2. Check that connecting cables and connectors not damaged.
	CF card board failure	Replace the CF card board.
	Mother board failure	Replace the mother board.

4.6.9 Power Supply Failures

Symptoms	Possible Cause	Corrective Action
Different battery voltages	Battery failure	Replace battery.
	Cable defective or poorly connected	1. Check that the cable between battery interface board and power module is correctly connected. 2. Check that cables and connectors are not damaged.
	Power board failure	Replace the power board.
Battery capacity is too low	Battery failure	Replace battery.
	Cable defective or poorly connected	1. Check that the cable is correctly connected. 2. Check that connecting cables and connectors are not damaged.
	Power board failure	Replace the power board.
Battery cannot be recharged	Battery failure	Replace battery and recharge the replacement battery. If the replacement battery can be recharged, the original one fails.

	Cable defective or poorly connected	1. Check that cable between battery interface board and power module is correctly connected. 2. Check that cables and connectors are not damaged.
	Power board failure	Replace power board
No +3.3 V output	Power supply protection Power board failure	1. Turn off the monitor then restart it. 2. If the problem remains, disconnect the AC mains for 5 s and reconnect it, then restart the patient monitor. 3. If the problem still remains, replace power board.
No +5.0 V output		
No +5.0 V CIS output		
No +12 V output		

NOTE

- **When the power module has a failure, it may cause problems to other components, e.g. the monitor suddenly breaks down during start-up, as the power module may have a power supply protection. In this case, troubleshoot the power module per the procedure described in the table above.**
- **Components of the main unit, SMR and parameter modules are powered by the power module. In the event that a component malfunctions, check if the operating voltage is correct. Refer to *2 Theory of Operation* for the operating voltage and measurement points of each component.**

4.6.10 Network Related Problems

Symptoms	Possible Cause	Corrective Action
The patient monitor cannot be connected to a CIS.	No connection to LAN	1. Check that the cables and connectors are in good condition and that the network is correctly connected. 2. Check that the hub or switch is correctly configured.
	CIS assembly failure	1. Restart the patient monitor, check that a beep is heard and the CIS fan runs normally after the system starts up. 2. After starting, select [**Main Menu**]→ [**Maintenance>>**]→[**User Maintenance>>**] → enter the password required. In the [**User Maintenance**] menu, [**CIS Maintenance**] shall be enabled and switching between normal monitor screen and CIS screen is possible. 3. If step 1 and 2 fail, check the CIS fan assembly for damage and if the power supply to the CIS assembly is correct. If both of them work correctly, replace the CIS assembly.
	DVI interface board failure	Replace DVI interface board.
Frequent dropouts and network disconnects	Incorrect LAN cable connection	Check LAN cable connection. LAN cable shall not be longer than 50 m.
	Incorrect IP address configuration	Check for IP address conflict. Reconfigure IP address.
The patient monitor is connected to a LAN but cannot view other patients under the View Others mode	Incorrect LAN cable connection	Check LAN cable connection. LAN cable shall not be longer than 50m.
	Excessive requests for viewing the patient monitor at the same time	A patient monitor can only be viewed by 4 other patient monitors at the same time under the View Others mode. The excessive view requests system will be ignored.
	Incorrect IP configuration	Check for IP address conflict. Reconfigure IP address.
	CIS assembly failure	Replace CIS assembly.

4.6.11 Software Upgrade Problems

Symptoms	Possible Cause	Corrective Action
Boot file upgrade fails	Power failure or unintended power off during boot file upgrade	Return the CPU board to factory for repair.
Program upgrade fails	Incorrect network connection	1. Check that network connector, not CIS connector, on the patient monitor is used. 2. Make sure that the hub or switch run normally. Check that net twines are of the right type and have been connected correctly.
	Wrong upgrade package has been downloaded	Upgrade package shall be .pkg files. Select package according to system requirement.
	Incorrect IP address configuration	Configure a fixed IP address in range C as specified for the patient monitor. We recommend not to upgrade a program when the patient monitor is connected to a network with multiple PCs.

4.6.12 Technical Alarm Messages

Please refer to the Operator's manual.

4.6.13 M51A Self Test Information

New MPM module applies the integrative parameter board (ECG ASIC).

MPM Selftest Item	Test Value	Test Value (New MPM module)	Corrective Action
DSP selftest information	Not F	Not FF	Replace the module
7024 selftest information	Not 7F		
2131 selftest information	Not 1F		
ECG module selftest information	Normal value：7 for 3/5 lead module; FF for 12-lead module		

4.6.14 Device Integration Failures

Symptoms	Possible Cause	Corrective Action
The [**Devices Integrated**] window displays nothing after connection.	The ID adapter is not compatible with the external device.	1. Replace the ID adapter. 2. Upgrade the ID adapter in [**Factory Maintenance**] menu to make the ID adapter match the corresponding external device. See ***3.11.1 Device Connection and Setup*** for more about the setup of the ID.
	The serial port adapting cable is not compatible with the external device.	Replace the serial port adapting cable.
Generate the alarm: [**BeneLink Comm Stop**].	The application of the BeneLink module is damaged.	Update or upgrade the application of the BeneLink module with the network upgrading tool.
The patient monitor has no response when loading the ID adapter.	The application of the BeneLink module is damaged.	Update or upgrade the application of the BeneLink module with the network upgrading tool.
	The kernel or the document system of the BeneLink module is damaged.	Return the BeneLink module to factory for repair.

FOR YOUR NOTES

5 Repair and Disassembly

5.1 Tools

During disassembly and replacing, the following tools may be required:

- Phillips screwdrivers
- Small flat-bladed screwdrivers
- Contact spanner
- Tweezers
- Sharp nose pliers
- Sleeve

5.2 Preparations for Disassembly

Before disassembling the monitor, finish the following preparations:

- Stop monitoring the patient, turn off the monitor and disconnect all the accessories and peripheral devices.
- Disconnect the AC power source and take out both of the batteries.
- Pull off all the modules in the integral module rack. If the SMR is connected, disconnect the SMR from the monitor and then remove all the modules in it.

⚠WARNING

- **Before disassembling the monitor, be sure to eliminate the static charges first. When disassembling the parts labeled with static-sensitive symbols, make sure you are wearing electrostatic discharge protection such as antistatic wristband or gloves to avoid damaging the equipment.**
- **Put the cables or wires in place when reassemble the monitor to avoid short circuit.**
- **When assembling the monitor, be sure to select proper screws. If an unfit screw is tightened by force, the monitor may be damaged and the screw or the part may fall off during use to cause unpredictable damage or human injury.**
- **Be sure to follow the correct sequence to disassembly the monitor. Otherwise, the monitor may be damaged permanently.**
- **Be sure to disconnect all the cables before disassembling any parts. Be sure not to damage any cables or connectors.**
- **Be sure to place the monitor face up when disassembling it. Otherwise, the screen or the knob may be scratched or damaged.**

5.3 Basic Disassembly

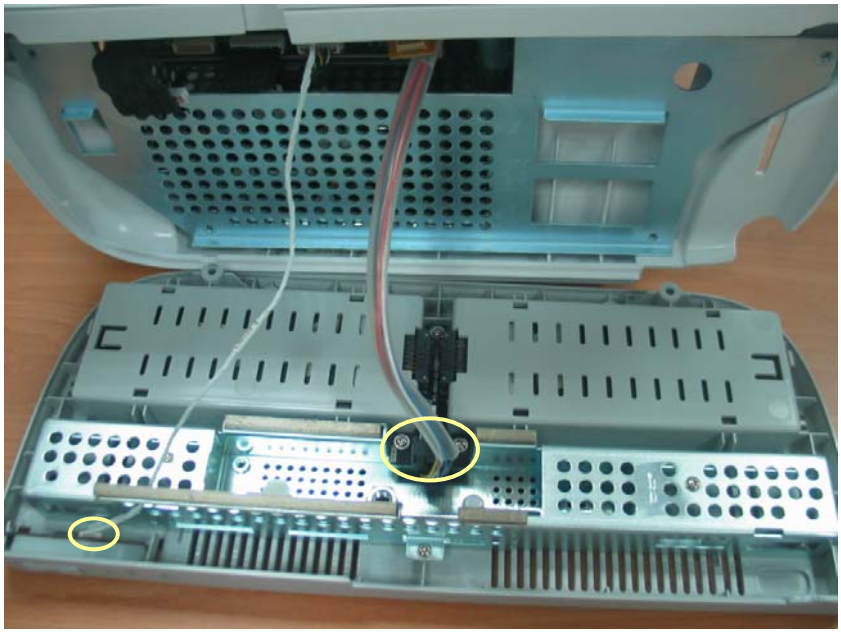
5.3.1 Disconnecting the Base

NOTE

- **Be sure to disassemble the base first before proceeding with other parts.**
- **Be sure to place the monitor face up when disassembling it. If lay the monitor face down, be sure the surface is non-abrasive and static-free. Otherwise, the screen or the knob may be scratched or damaged.**

1. The hook that prevents the power plug off is located beside the AC port in the rear case of the monitor. Remove this hook and then place the monitor face up and unscrew the four M4×12 screws, as shown in the figure below.

2. Pull out the base and then unplug the two cables marked in the picture, one connecting the Power Switch & LED board and the button board, and the other connecting the battery interface board and the power supply assembly.

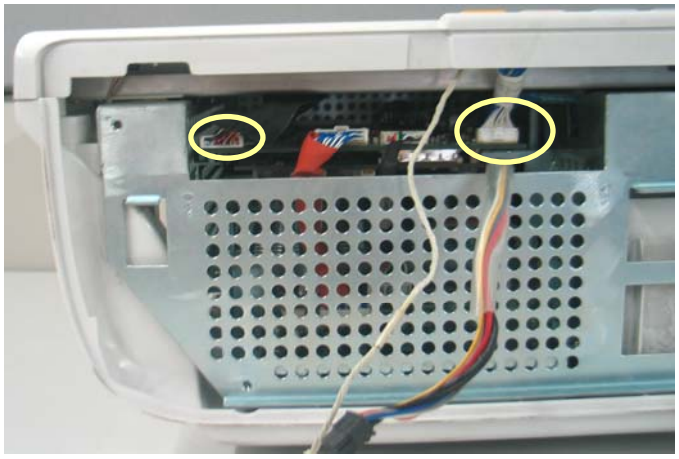


NOTE

- **Exercise care when pulling the base out. Be sure not to damage the cables and connectors.**

5.3.2 Separating the Front and Rear Half of the Monitor

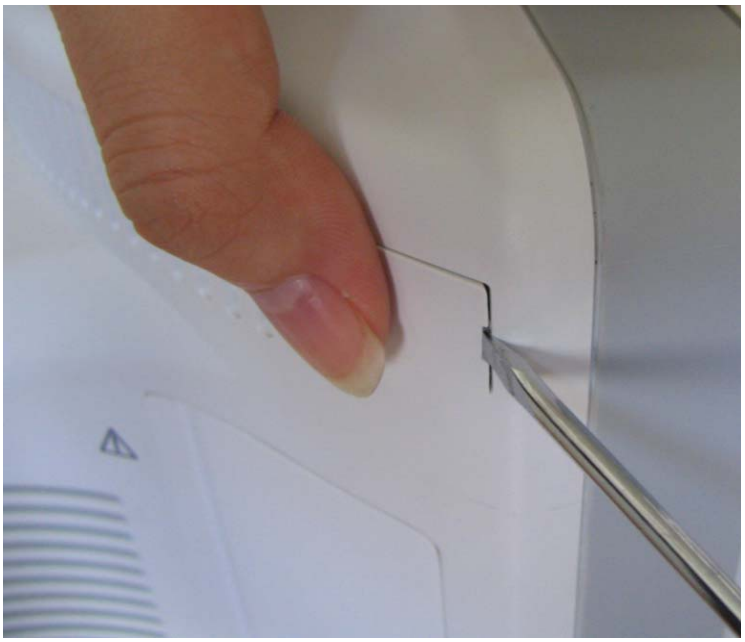
1. Keep the monitor (without the base) face up. Disconnect the cables marked in the picture, one connecting the LCD panel and the mother board, and the other connecting the button board and the mother board.



NOTE

- **Release the clip before disconnecting the cable between the button board and the mother board.**

2. Carefully place the monitor face down. Pry up the four screw covers with a small flat-bladed screwdriver and unscrew the four M3×12 screws exposed. Then unscrew the M3×12 screw in the handle.



NOTE

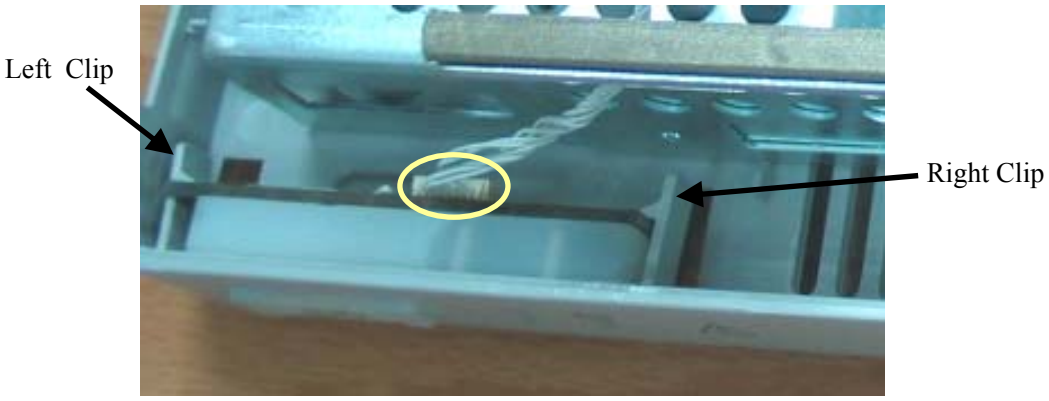
- **Press the cover with a thumb when prying it.**
- **Avoid pressing the knob on the table.**

3. Lift the rear cover assembly to separate it from the front cover assembly.

5.4 Further Disassembly

5.4.1 Removing the Power Switch & LED Board

1. Locate the cable marked in the picture and disconnect it from the power switch & LED board.



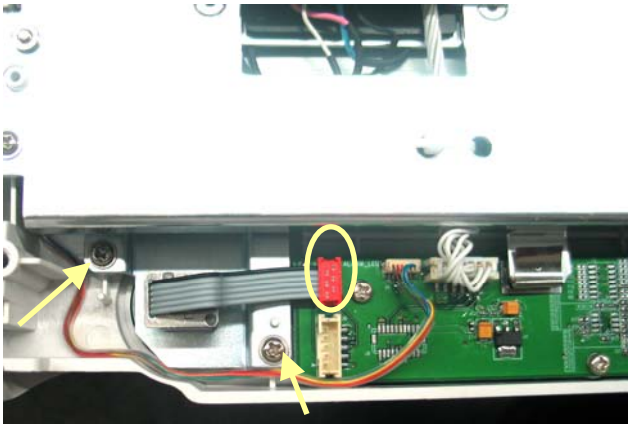
2. Release the clips with fingers. At the same time pinch the power switch & LED board, push it to the left and take it out along with the power switch.

NOTE

- **Exercise care whe releasing the clips.**
- **When installing the LED board along with the power switch, put it on the left clip, unclench the right clip to the right direction slightly, and then press it down.**

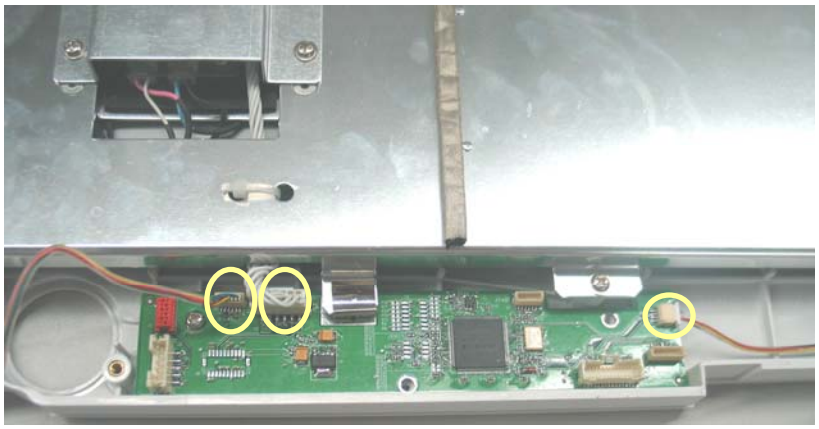
5.4.2 Disconnecting the Encoder Assembly

1. Disconnect the cable that connects the knob encoder and the button board. Then unscrew the two M3×6 screws and take out the encoder assembly.

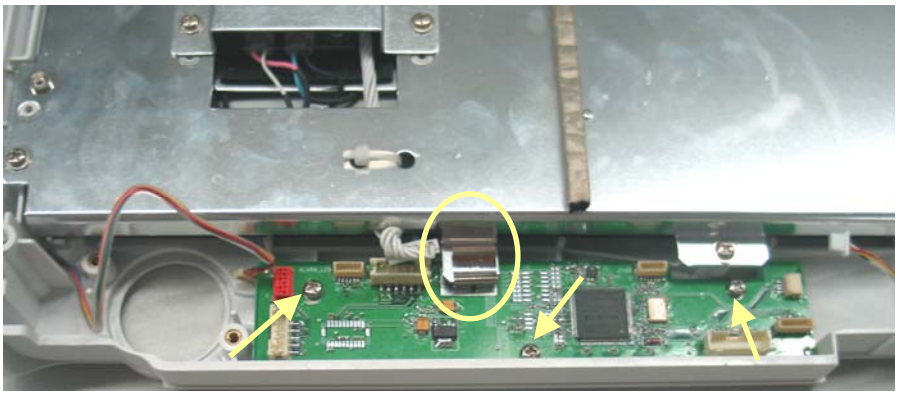


5.4.3 Removing the Button Board

1. Disconnect the cables from the button board to the power switch & LED board, knob encoder, alarm LED board, backlight board and, touchscreen control board and the mother board.



2. Remove the grounding spring and then unscrew the three PT3×8 screws and take out the button board.



NOTE

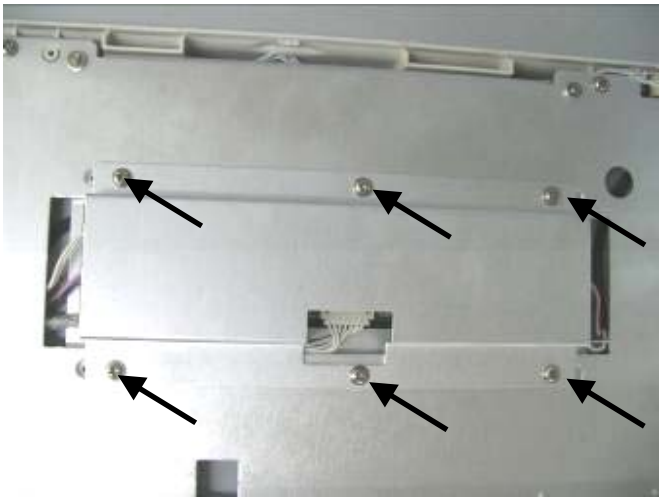
- **Do not forget the grounding spring when reassembling.**

5.4.4 Removing the Touchscreen Control Board

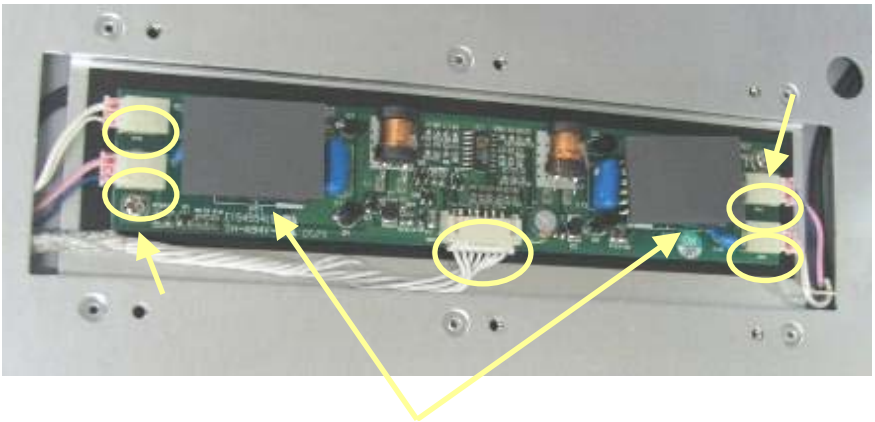
Unplug the touchscreen cable and the cable from the button board to the touchscreen control board. Then, unscrew the two M3×6 screws and remove the touchscreen control board.

5.4.5 Removing the Inverter

1. Unscrew the six M3×6 screws and remove the inverter shield.



2. Unplug the cables respectively from the button board and the LCD to the inverter. Then, unscrew the two M3×6 screws to remove the inverter.



Heat-conductive insulator

NOTE

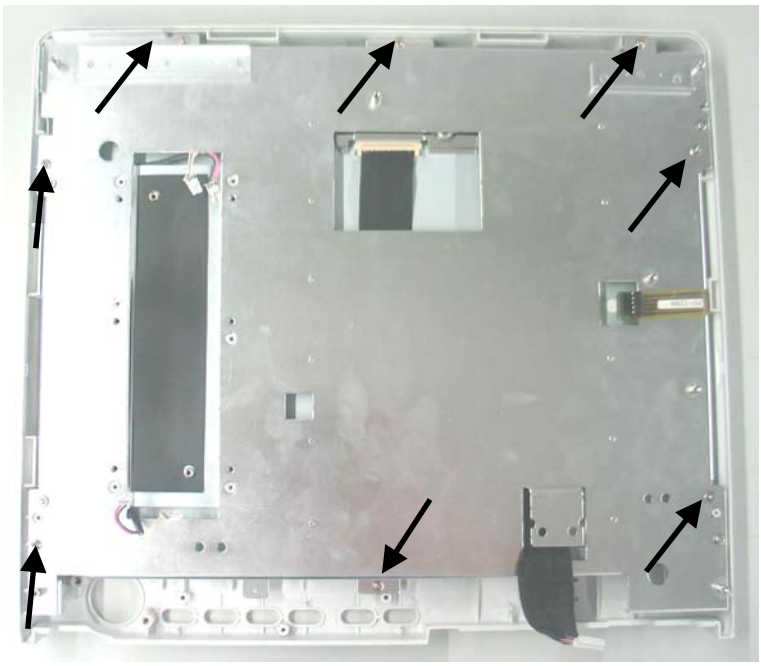
- **Release the clip (if any) before disconnecting the cable between the LCD and the inverter.**
- **When reassembling, check whether the two heat-conductive insulators are in place.**

5.4.6 Removing the LCD Screen

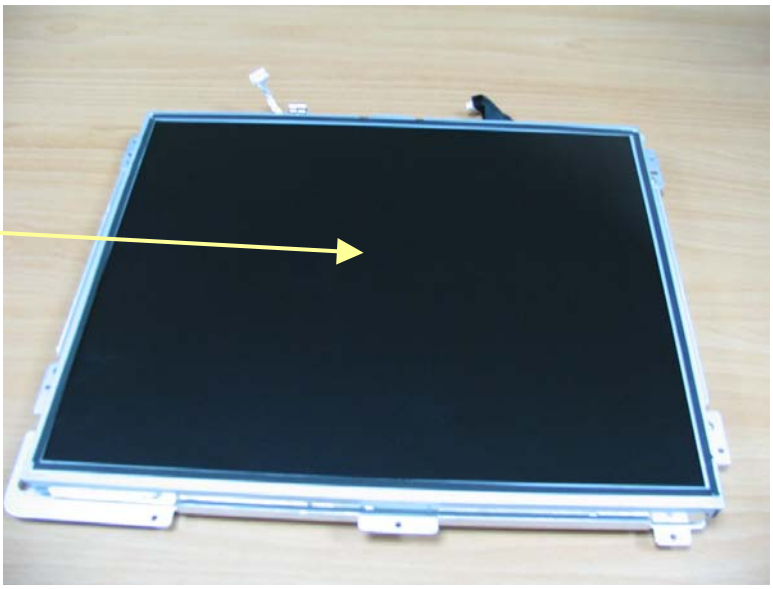
⚠CAUTION

- **Do not touch the LCD screen.**
- **Disassemble the LCD screen in an environment as dust-free as possible.**

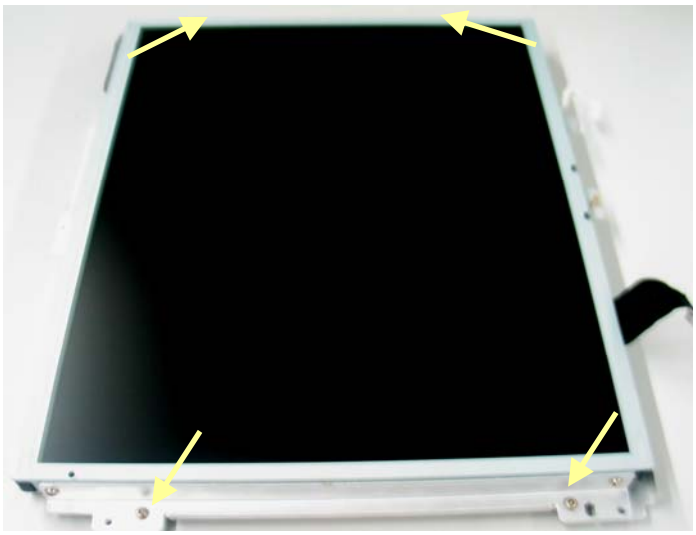
1. Unscrew the eight M3×6 screws and take the screen assembly out carefully. To prevent the screen from being contaminated by dust, do not touch the screen.



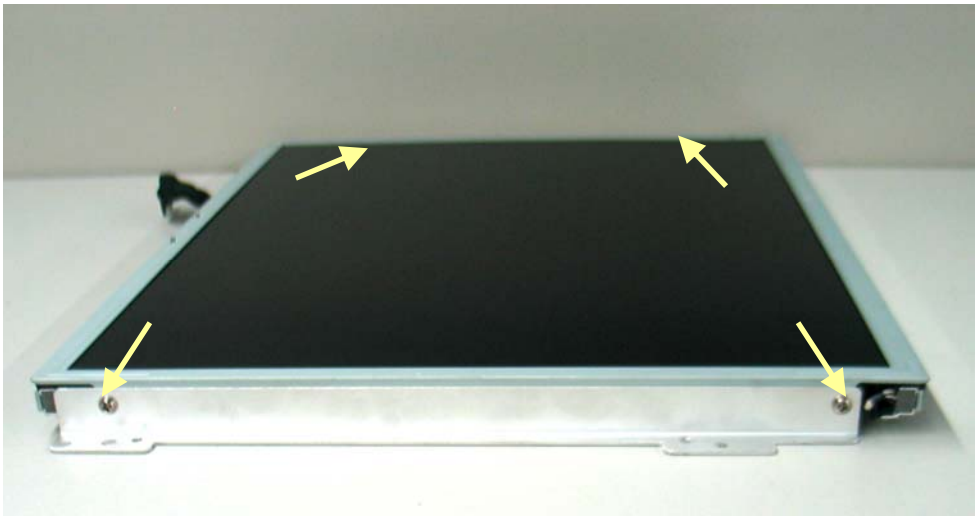
Do not touch the LCD panel



2. Unscrew the four M3X6 screws and take out the LCD screen.

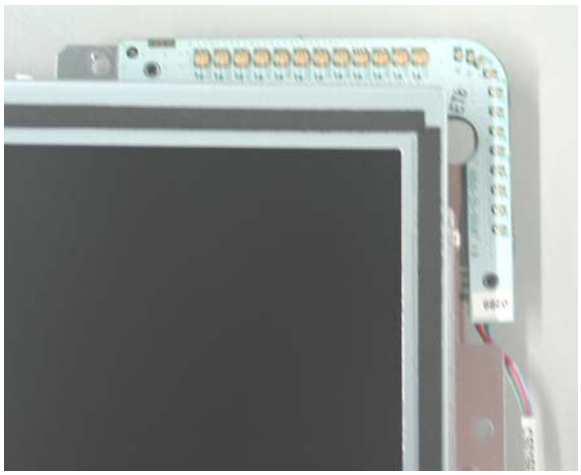


3. Unscrew the four M3X6 screws and separate the LCD screen from the two supporters.



5.4.7 Removing the Alarm Lamp Board

1. After removing the LCD panel, disconnect the cable that connects the alarm lamp board and the button board, and then remove the alarm lamp board on which there is no screw.



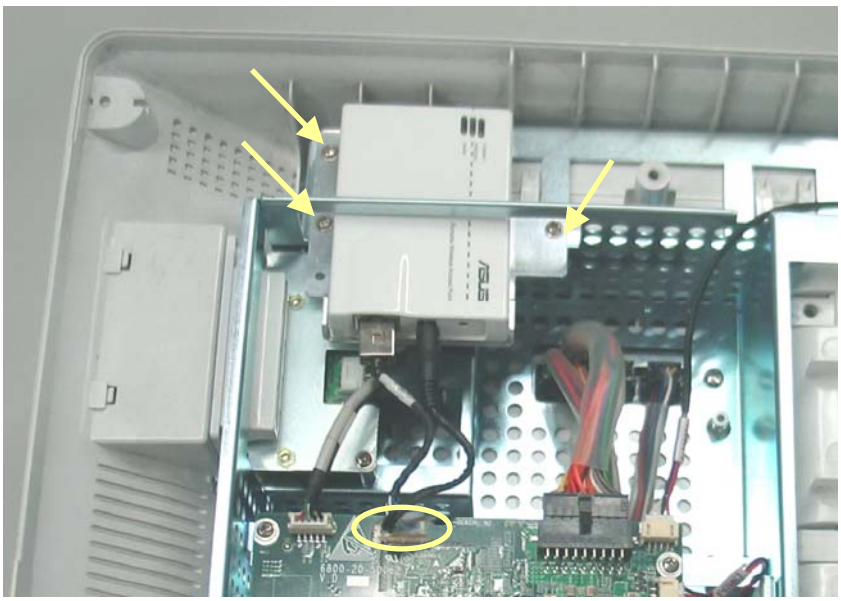
NOTE

- **Exercise care when removing the alarm lamp board because it may be adhered to the LCD assembly (as shown in the above figure).**

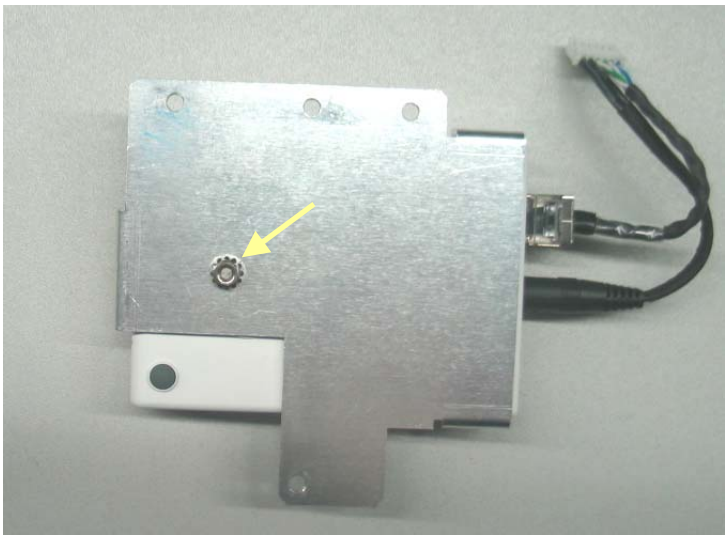
5.4.8 Removing the Wireless AP

5.4.8.1 Removing the Internal Wireless AP

1. Unplug the wireless AP cable from the main board. Then unscrew the three M3X6 screws and take out the wireless AP assembly.

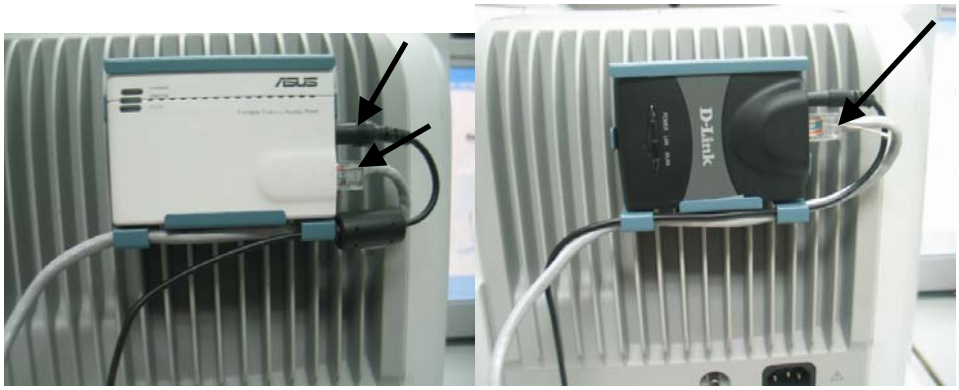


2. Unscrew the M3 nut and then remove the wireless AP.

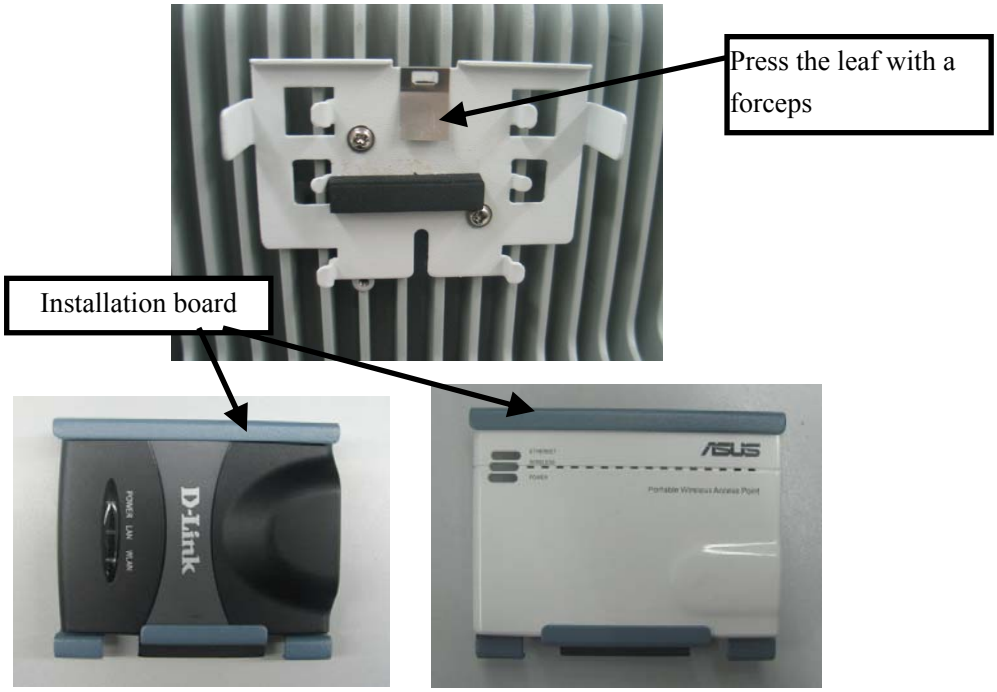


5.4.8.2 Removing the External Wireless AP

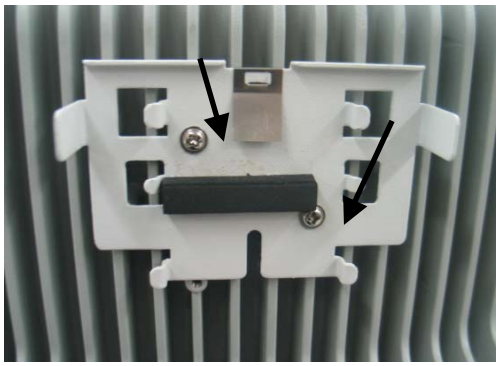
1. Disconnect the network cable and the power cord



2. Press the leaf on the fix board with forceps; push the AP and installation board upwards. Then remove the AP and installation board.

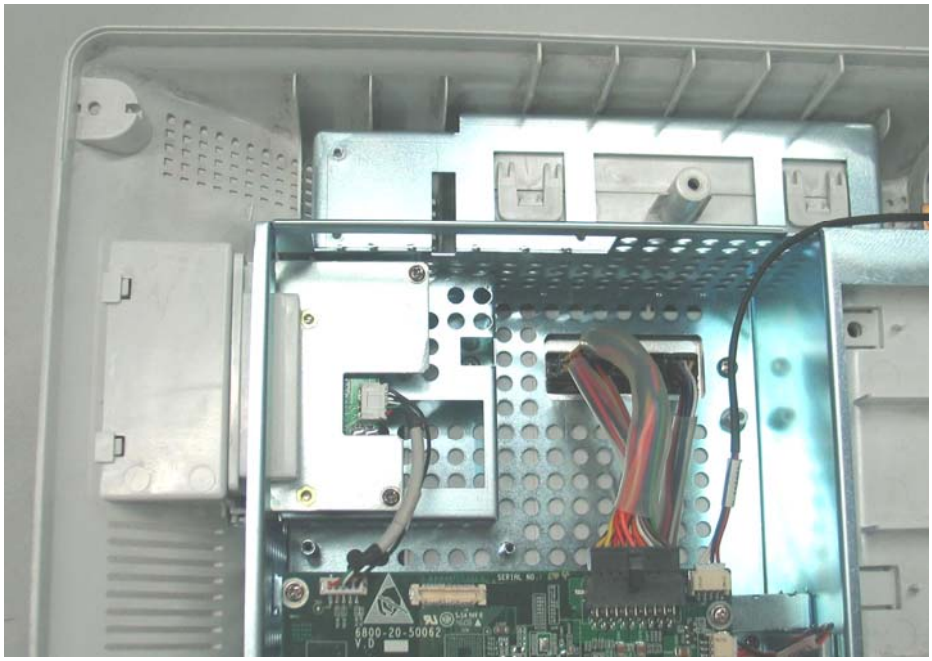


3. Unscrew the two M3×8 screws and take out the fix board.

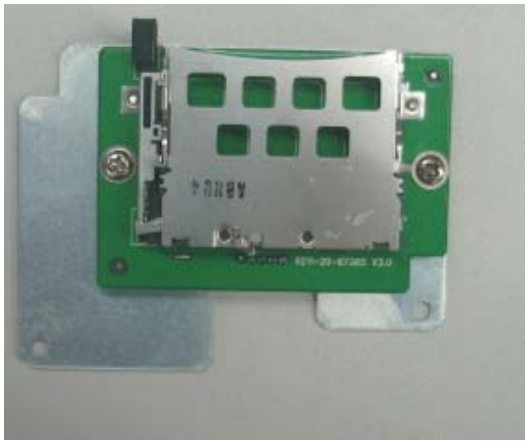


5.4.9 Removing the CF Assembly

1. Disconnect the cable between the CF driving board and main board. Unscrew the two M3X6 screws and take out the CF assembly.



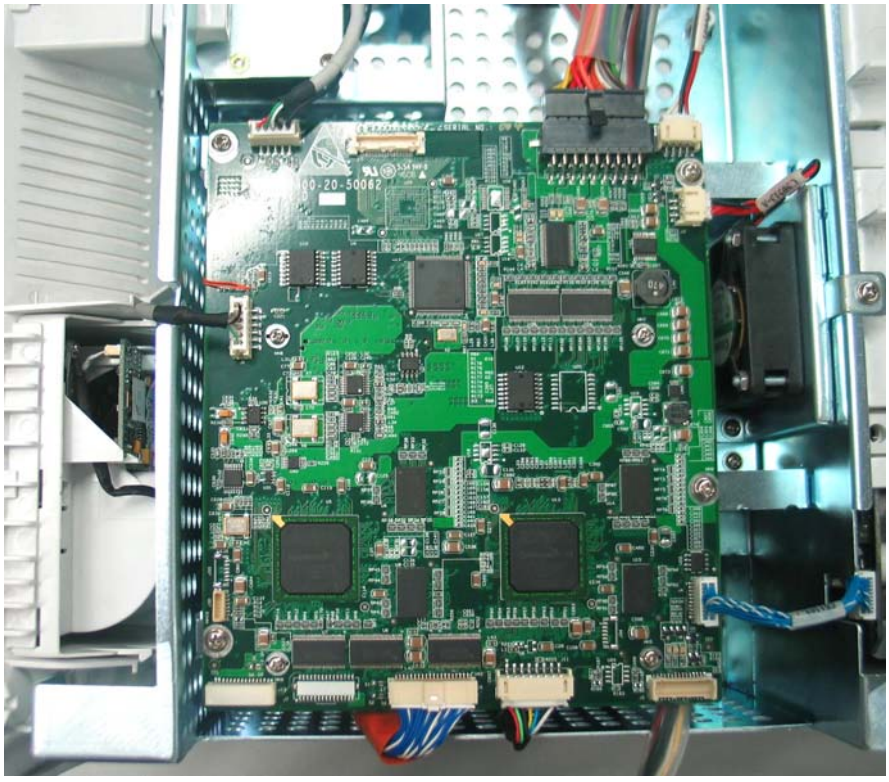
2. Unscrew the two M3X6 screws and take out the CF driving board.



5.4.10 Removing the Main Board

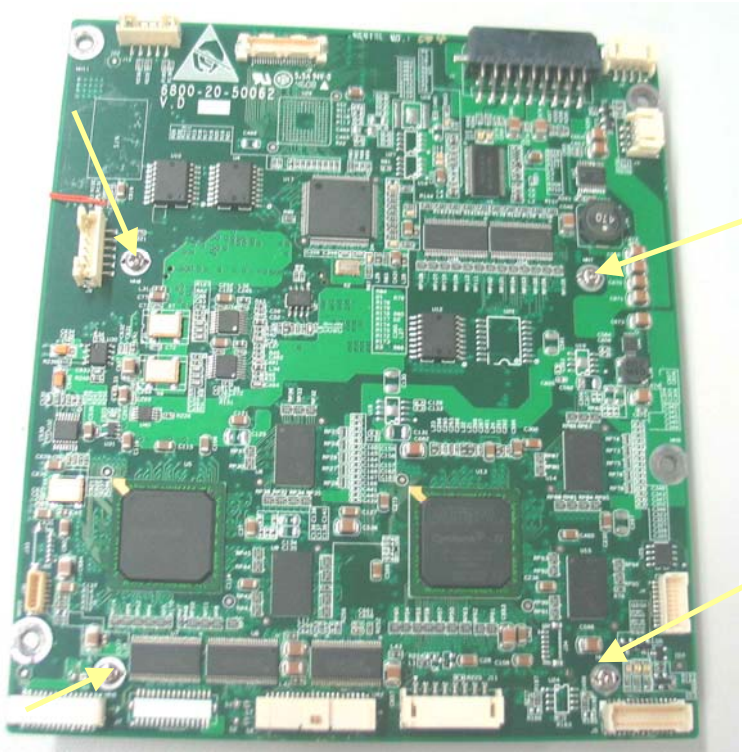
1. Pull out all the connectors on the mother board. There are numbers beside the connectors, which are listed below.

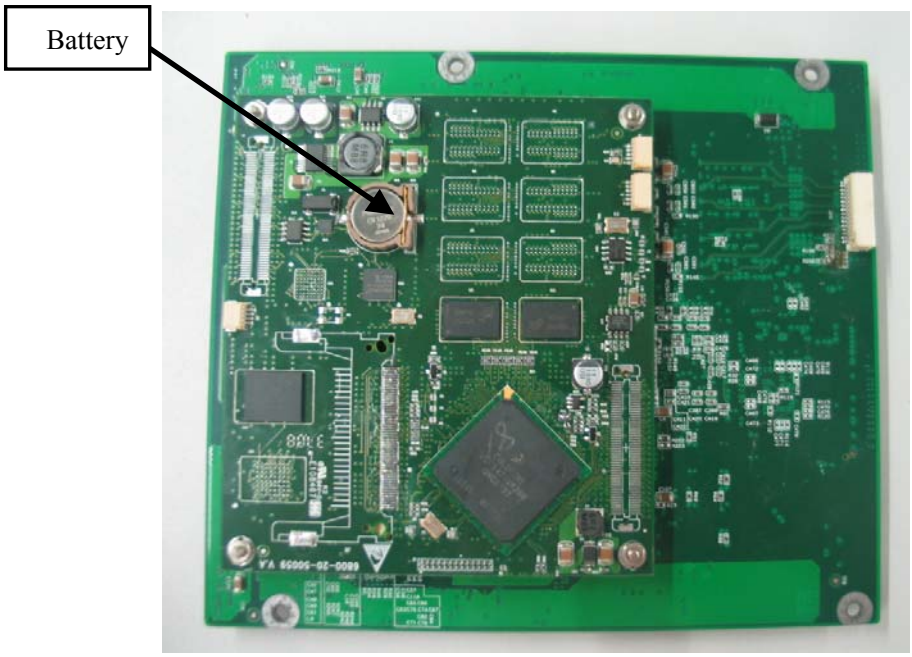
Number	Connected to
J1	Power module
J2	Speaker
J3	Fan
J4	Integral module rack
J5	Button board
J6	DVI interface board
J7	LCD panel
J8	Recorder
J16	Wireless AP
J10	CIS assembly
J11	USB interface board
J12	CF assembly
J22/J23	CPU board, which is connected to the mother board with a socket



2. Unscrew the four M3×6 screws as shown in the figure above and take out the main board that includes the mother board and the CPU board.

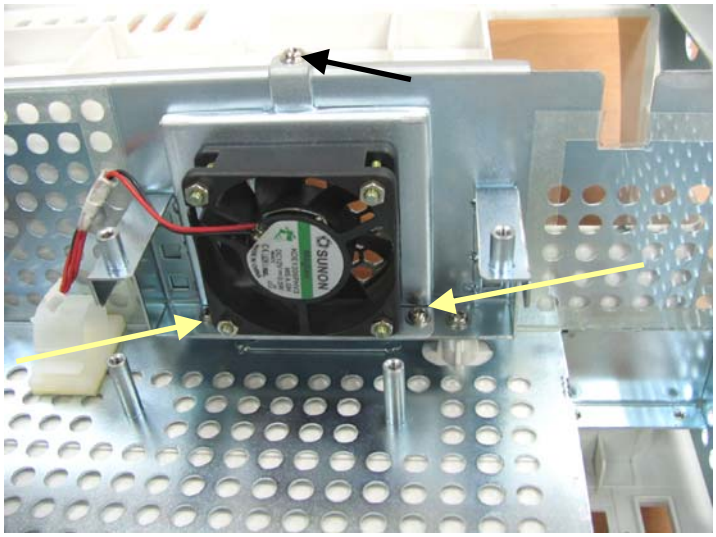
3. Unscrew the four M2.5×6 screws and separate the mother board from the CPU board. Be sure not to damage the socket that connects the two boards. There is a battery on the CPU board.





5.4.11 Removing the Fan

1. Disconnect the connector that connects the fan and the mother board. Then unscrew the three M3×6 screws and remove the fan.



5.4.12 Removing the Speaker

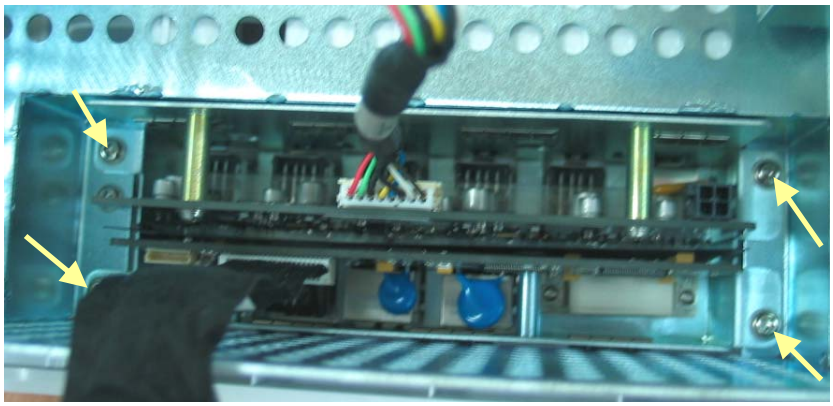
1. Disconnect the connector that connects the speaker and the mother board. Then unscrew the two M3×6 screws and remove the speaker.

⚠CAUTION

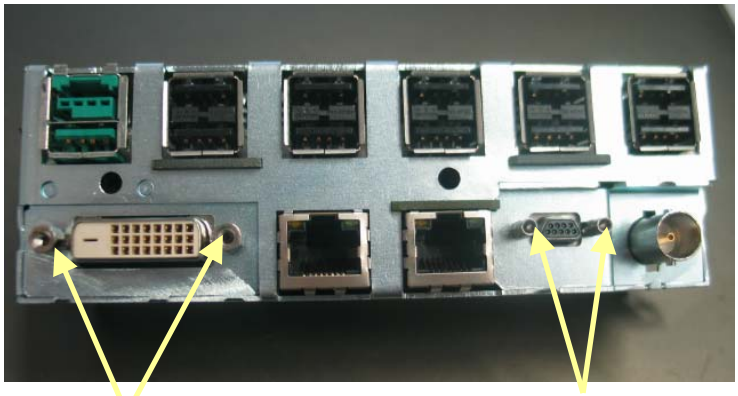
- **When installing a speaker, be sure to keep the cable from the press bar. Otherwise, the speaker may be short-circuited.**

5.4.13 Removing the Interface Board Assembly

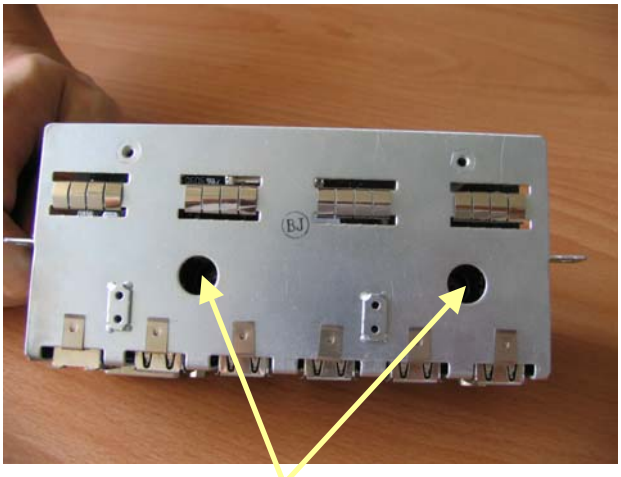
1. Unscrew the four M3×6 screws and remove the interface board assembly.



2. Unscrew the screws beside the DVI socket and micro-D socket. Then unscrew the two M3×6 screws in the holes. After that, pull out the DVI interface board.

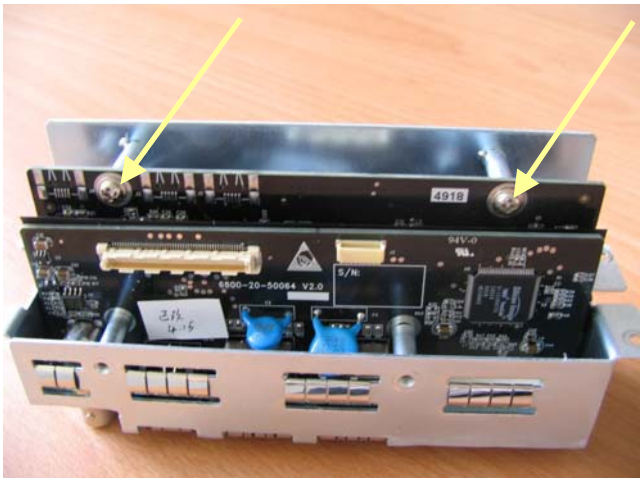


Screws beside DVI socket Screws beside micro-D socket



Two M3×6 Screws in Holes

3. Unscrew the two M3×6 screws and take out the USB interface board upwards.

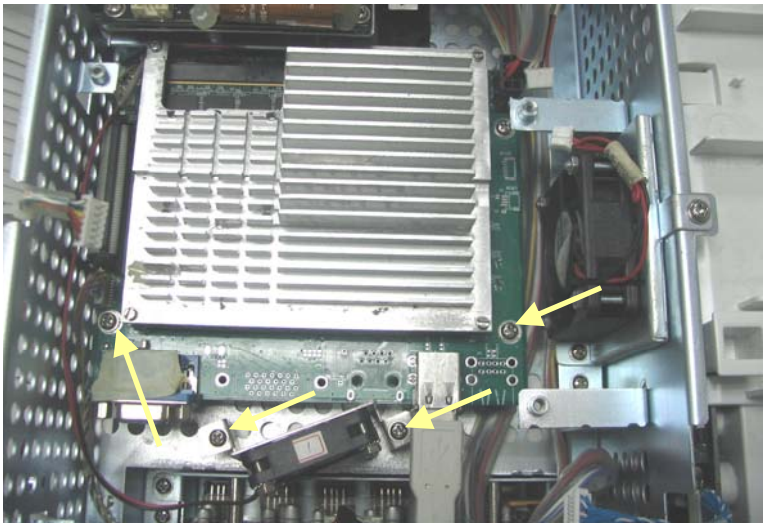


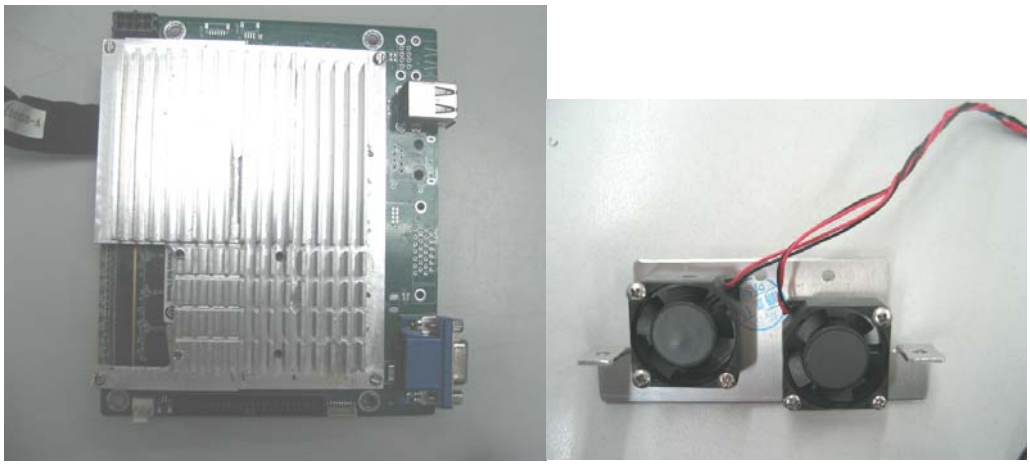
NOTE

- **Before removing the USB interface board, the DVI interface board must be removed first.**
- **Be careful not to damage the insulation between the DVI interface board and the USB interface board. If it is damaged, stick a new one.**

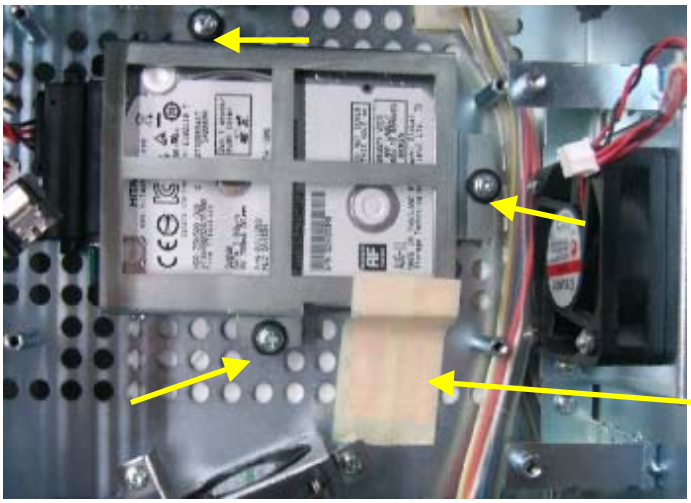
5.4.14 Removing the CIS Assembly

1. Pull out all the connectors on the CIS mother board. Unscrew the six M3×6 screws, and remove the CIS assembly and the fan assembly.





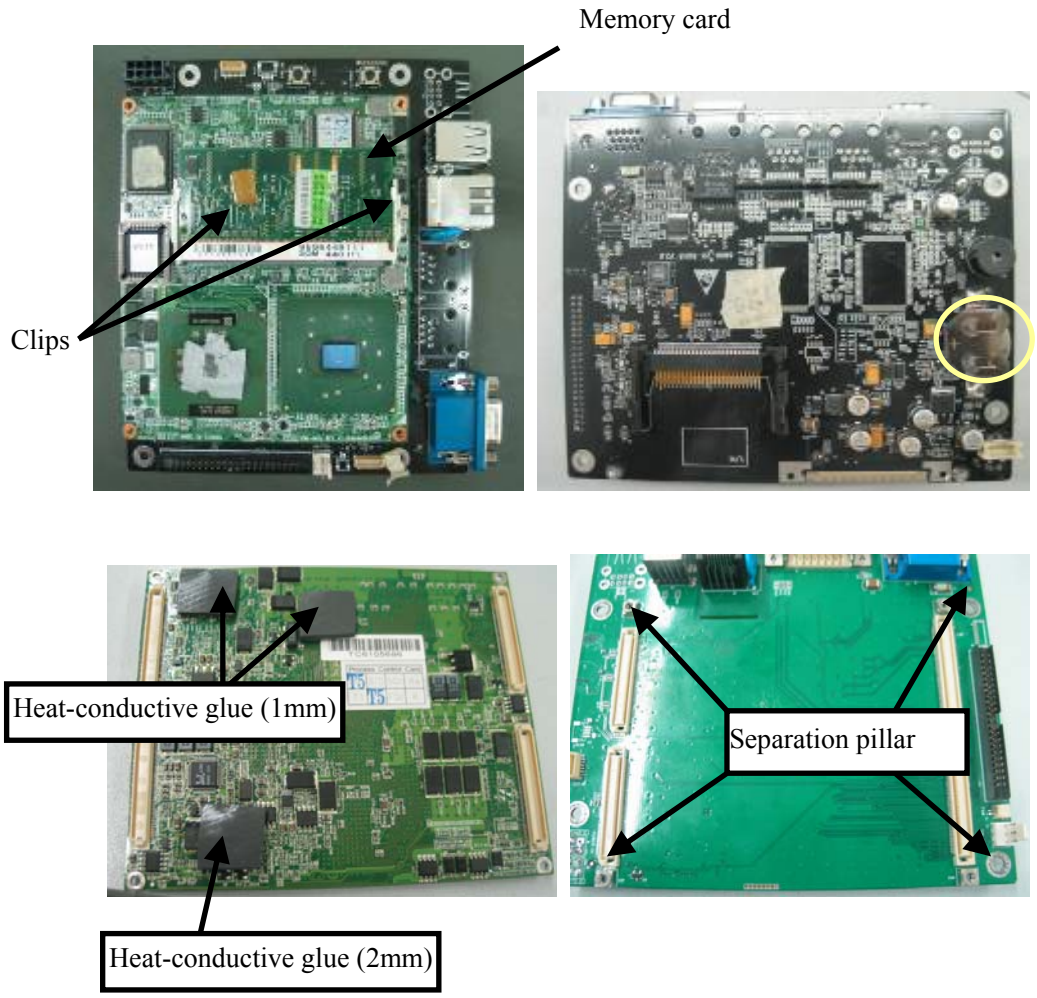
2. Remove the insulating gummed paper and the copper foil. Unscrew the three M3×6 screws and take out the CIS hard disk.



Insulating gummed paper & Copper foil

3. Unscrew the four nuts and remove the cooling fin in the industrial control board.

4. Release the two clips to remove the memory card. Separate the CIS mother board from the industrial control board. There is a battery on the CIS mother board.

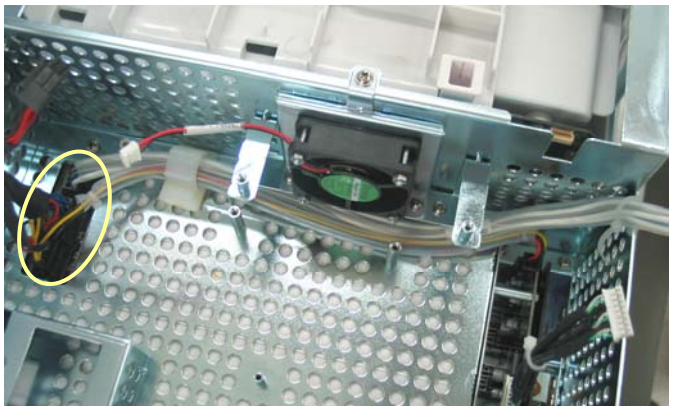


NOTE

- **Take care of the heat-conductive glue which lies between the industrial control board and the CIS mother board. Make sure the heat-conductive glue is coated before reinstallation. Remember to install the separation pillar to the CIS mother board whan reinstallation.**

5.4.15 Removing the Power Supply Assembly

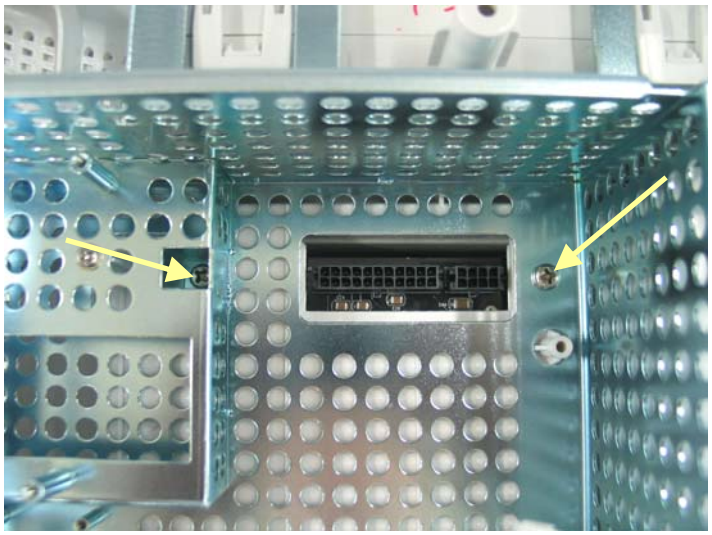
1. Disconnect the cables from the socket of the power supply.



NOTE

- **For some cables, you have to release the clips on it before disconnecting them.**

2. Unscrew the two M4×20 screws. Be sure to hold the power supply assembly to prevent it from falling when unscrewing the screws.

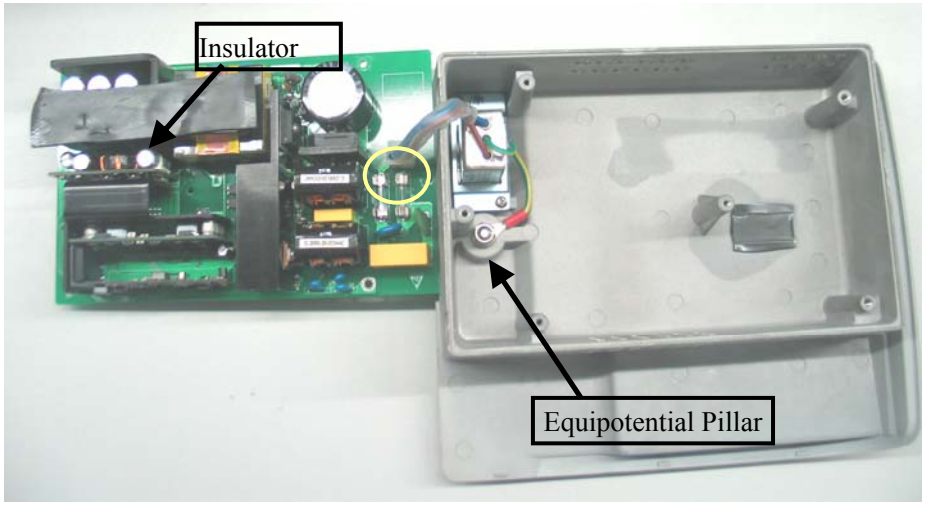


3. Lift the power supply assembly slightly to separate it from the two shafts on the rear cover and then remove the assembly.

Shafts

4. Unscrew the two M3×12 screws and remove the cover of the power supply.

5. Unscrew the two M3×6 screws. pry out the board with a small flat-bladed screwdriver in the gap between the power supply board and the housing. Then turn the board over and unplug the cables from it.



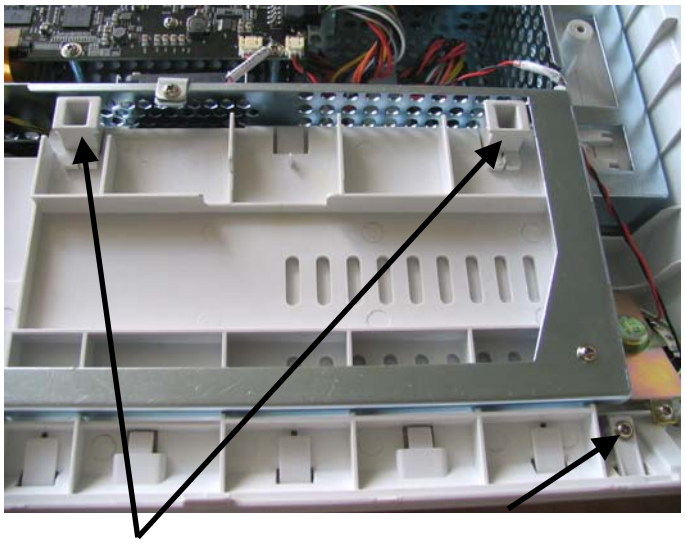
NOTE

- **Because the power supply board may be adhered to the insulator, be careful not to damage the parts, connector and cables when prizing it.**

5.4.16 Removing the Integral Module Rack

The following disassembling procedure takes the 5-slot module rack as an example. You can disassemble other types of module rack by referring to this procedure.

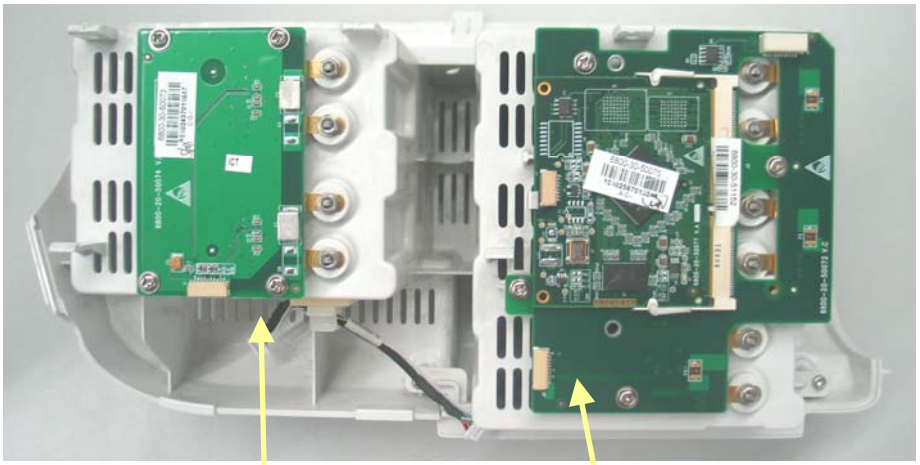
1. Disconnect the cable that connects the integral module rack and the mother board. Remove the two bolts and unscrew the M3×6 screw.



Bolts

2. Pry the snaps out about 1mm away with a small flat-bladed screwdriver. Then insert the small flat-bladed screwdriver into the position marked in the picture and pry it out about 1mm so that the module rack becomes disengaged from the back cover.

3. If the module rack still engages with the back cover, insert a small flat-bladed screwdriver into the position marked in the picture and pry it out about 1mm to release the hidden snap between the integral module rack and the back cover. Then pull out the module rack.



MPM Communication Board 3-slot module Rack Communication Board

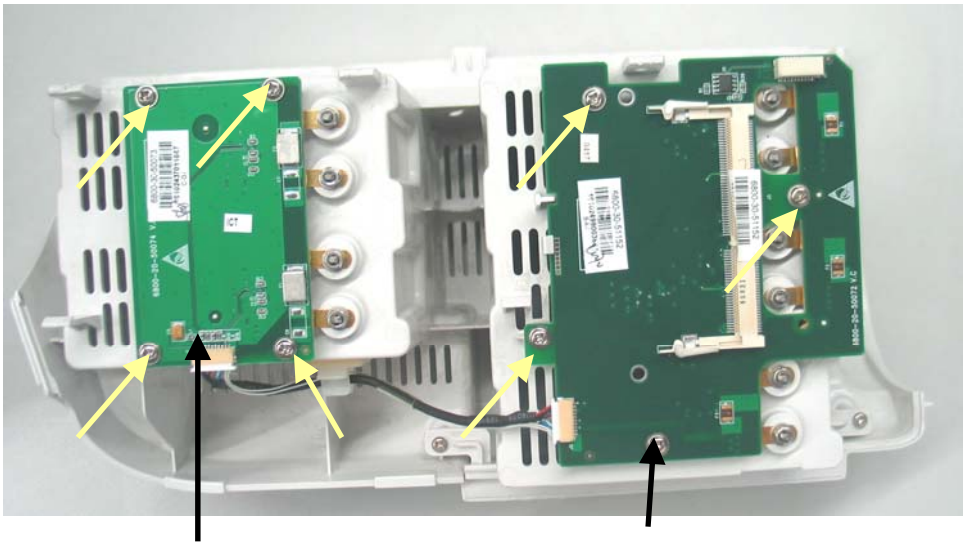
⚠CAUTION

- **Be sure to release the hidden snaps first when removing the integral module rack. Otherwise, the monitor will be damaged.**

4. Release the three clips on the 3-slot module rack communication board and remove the Nios II module.

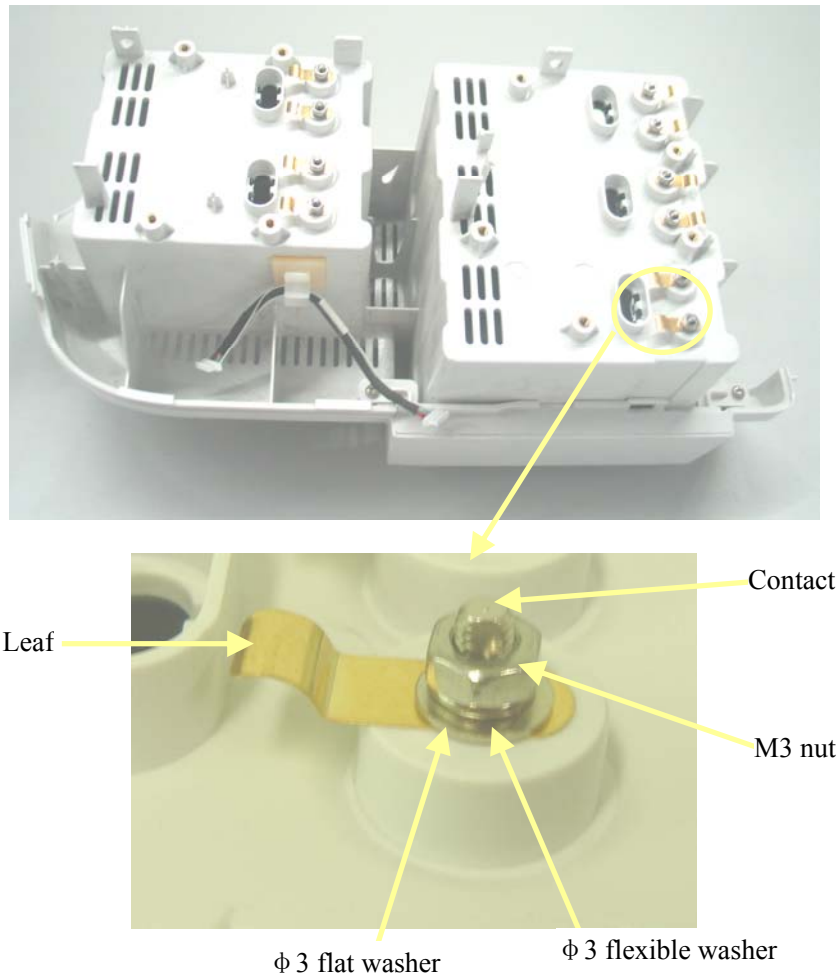
Nios II module

5. Unscrew the four M3X6 screws and take out the 3-slot module rack communication board. Unscrew the four M3X6 screws and take out the MPM Communication Board.



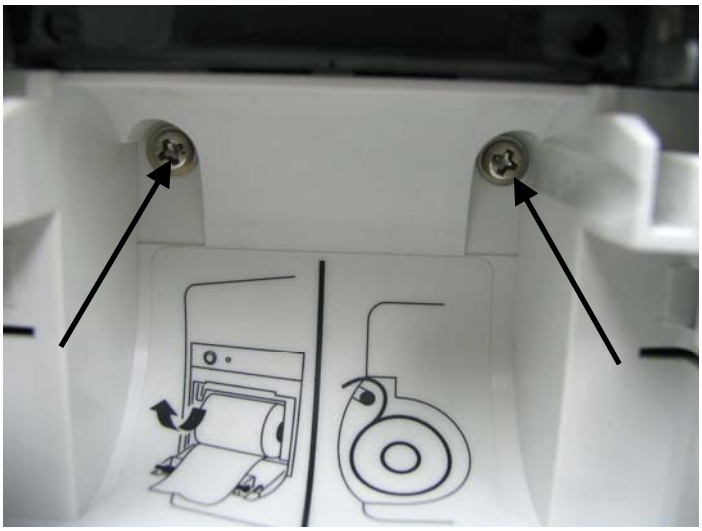
MPM Communication Board　　3-slot module Rack Communication Board

6. Unscrew the hex nut assy using the sleeve. Then separate the washer, spring and contact screw from each other.

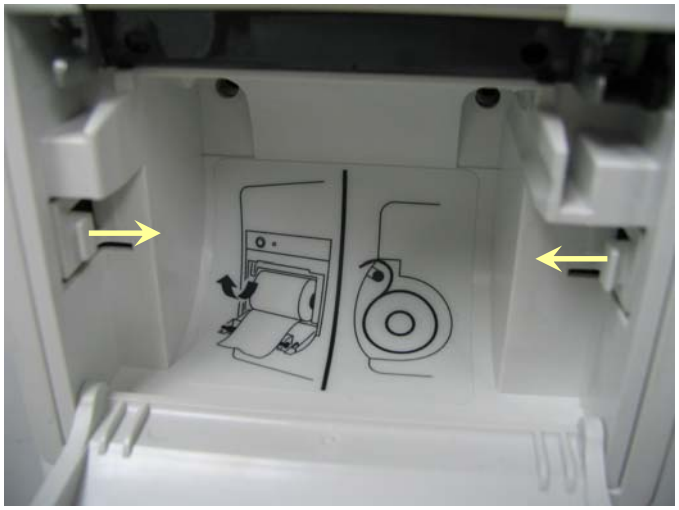


5.4.17 Removing the Recorder

1. Open the recorder door and unscrew the two M3×6 screws.



2. Pull the two clips in the directions as indicated and meanwhile pull out the recorder.

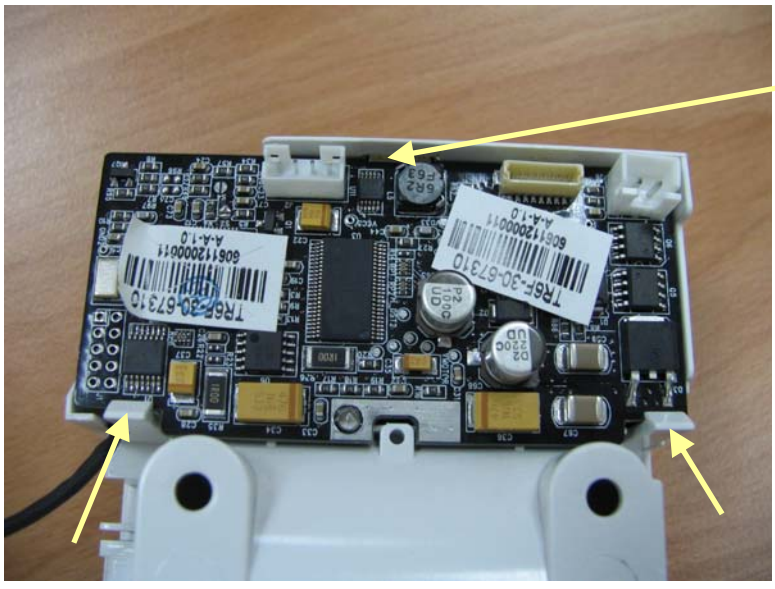


NOTE

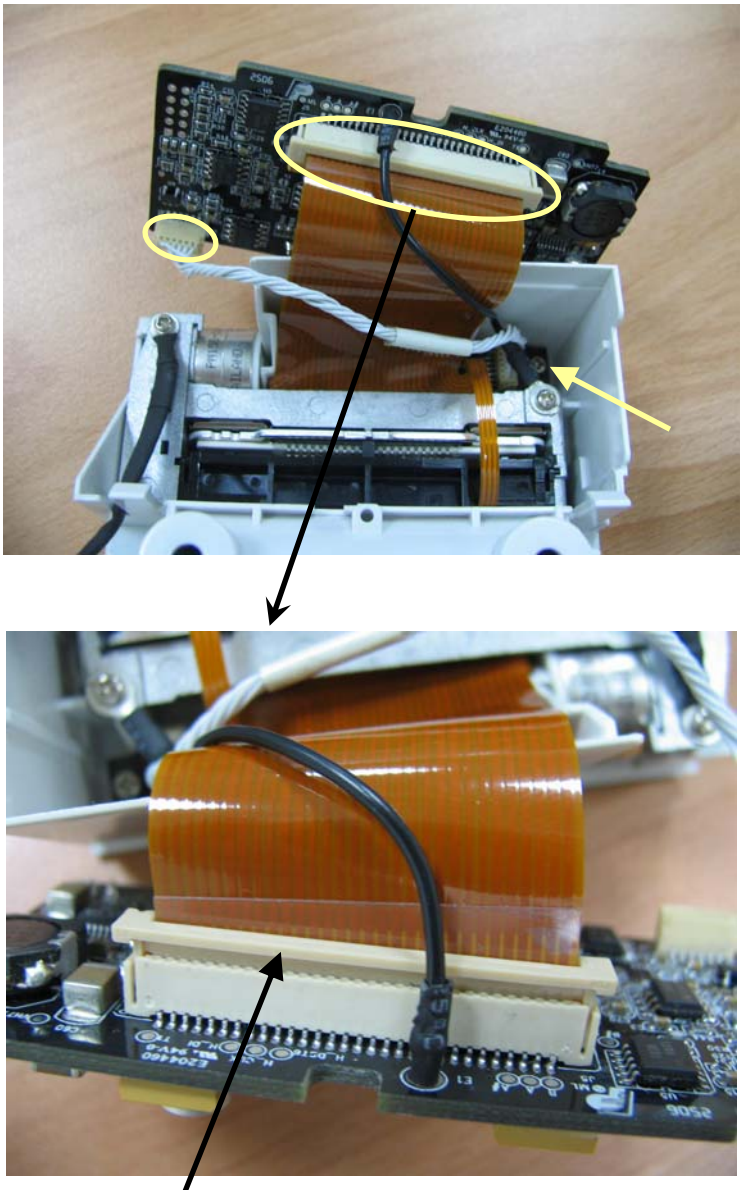
- **Be sure not to damage the connecting cables or connectors when pulling out the recorder.**

3. Unscrew the M3×6 screw and remove the cables marked in the picture.

4. Unclench the two clips and meanwhile take out the recorder drive board. Pay attention to the snap in the front.

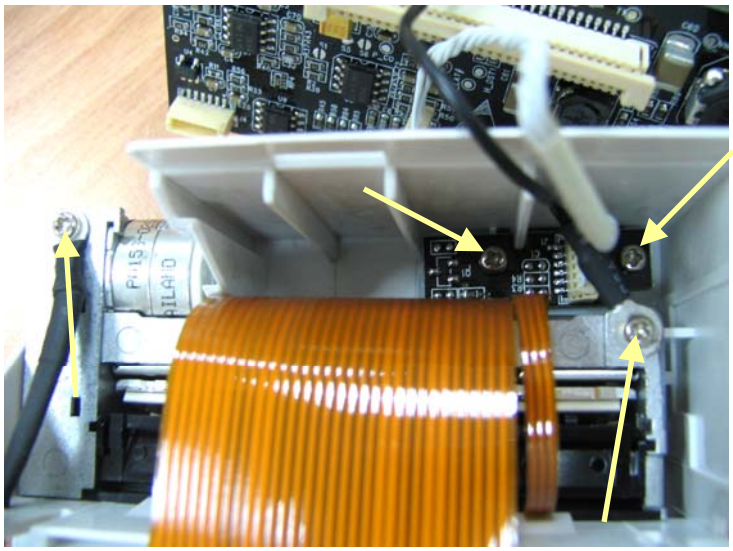


5. Pull out the press bar upwards about 1mm and then pull off the flexible cable. Remove the cable that connects the drive board and the button board. Unscrew the PT2×6 screw and remove the drive board's grounding cable. Then take out the recorder drive board.

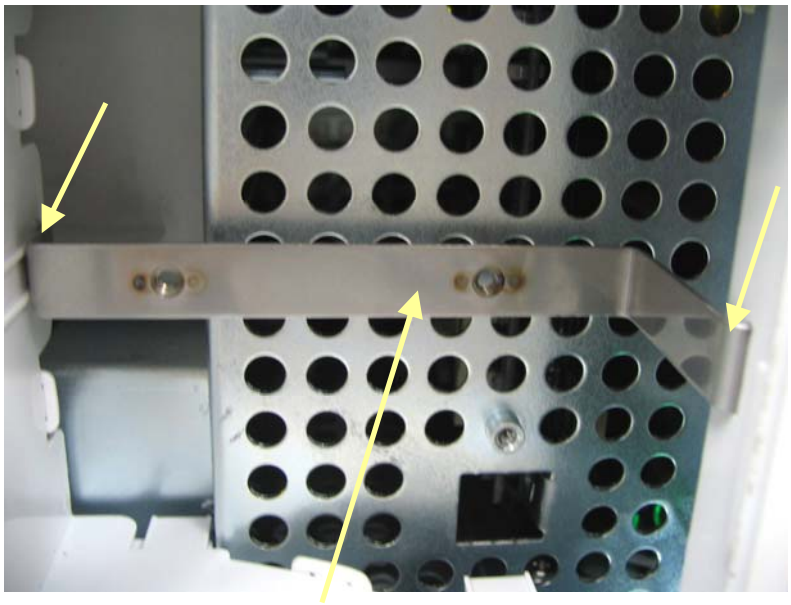


Press bar

6. Unscrew the two PT2×6 screws and take out the thermal printhead. Then unscrew the two PT2×6 screws and remove the recorder's button board.

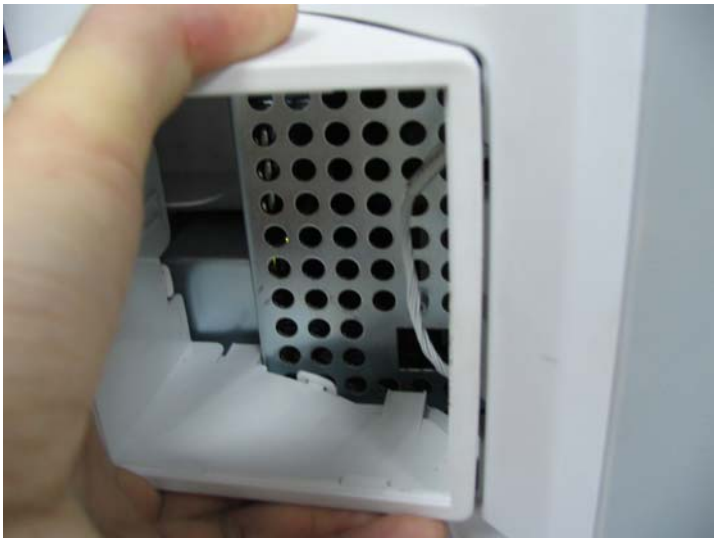


7. Remove the recorder mounting bracket by pulling out the recorder mounting bracket from the right side first.



Recorder mounting bracket

8. Hold and then pinch the recorder housing so that the recorder housing becomes disengaged from the monitor housing. Then take out the recorder housing.

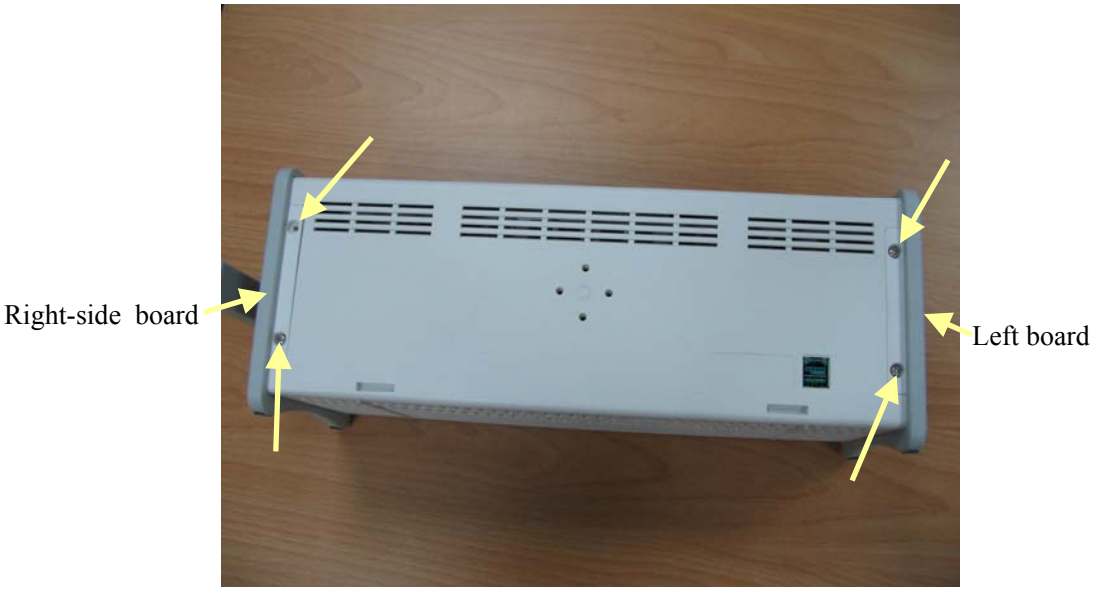


NOTE

- **When pinching the recorder housing, take care not to damage the recorder housing.**
- **When reassembling the recorder housing and the recorder mounting bracket, install the recorder mounting bracket first and meanwhile be sure the two clips are in right position. Otherwise, the recorder cannot be installed correctly.**

5.5 Removing the SMR Assembly

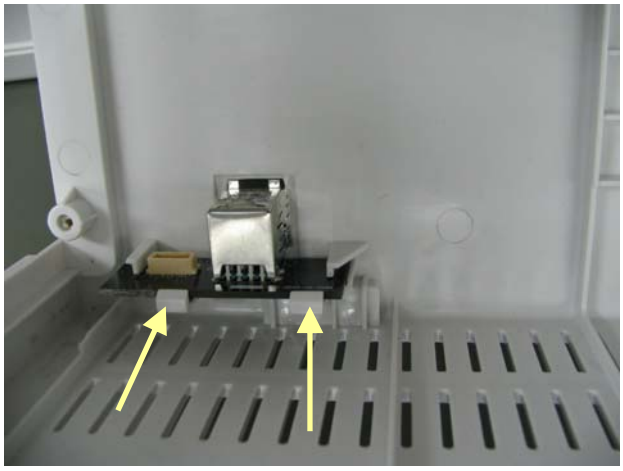
1. First remove the 4 screw covers and then unscrew the 4 M3×8 screws.



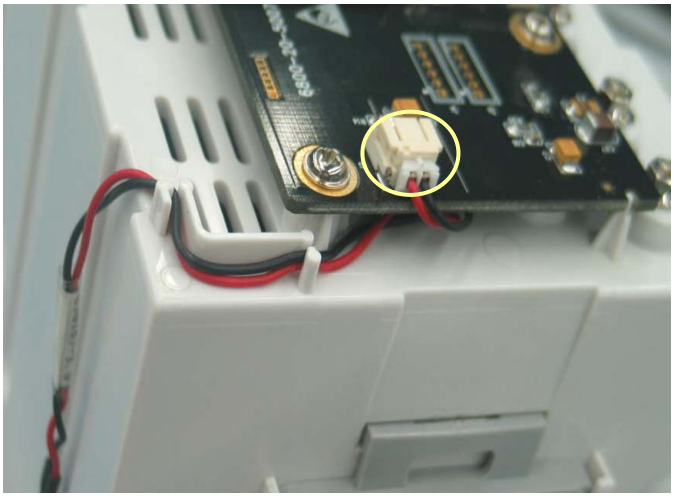
2. Pull off the left- and right-side boards. Be sure to place the rubber loop in position when reassembling the right board.

3. From the left side, remove the cable that connects the module rack interface board and the 8-slot module rack communication board. Then take off the SMR cover.

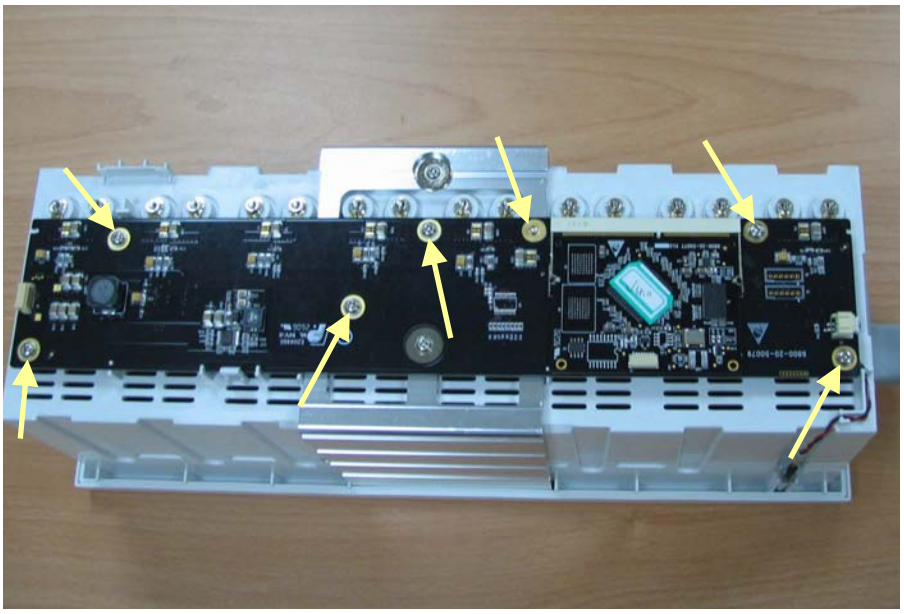
4. Unclench the two clips and take out the module rack interface board. Be sure not to damage the snap slot on the left side.



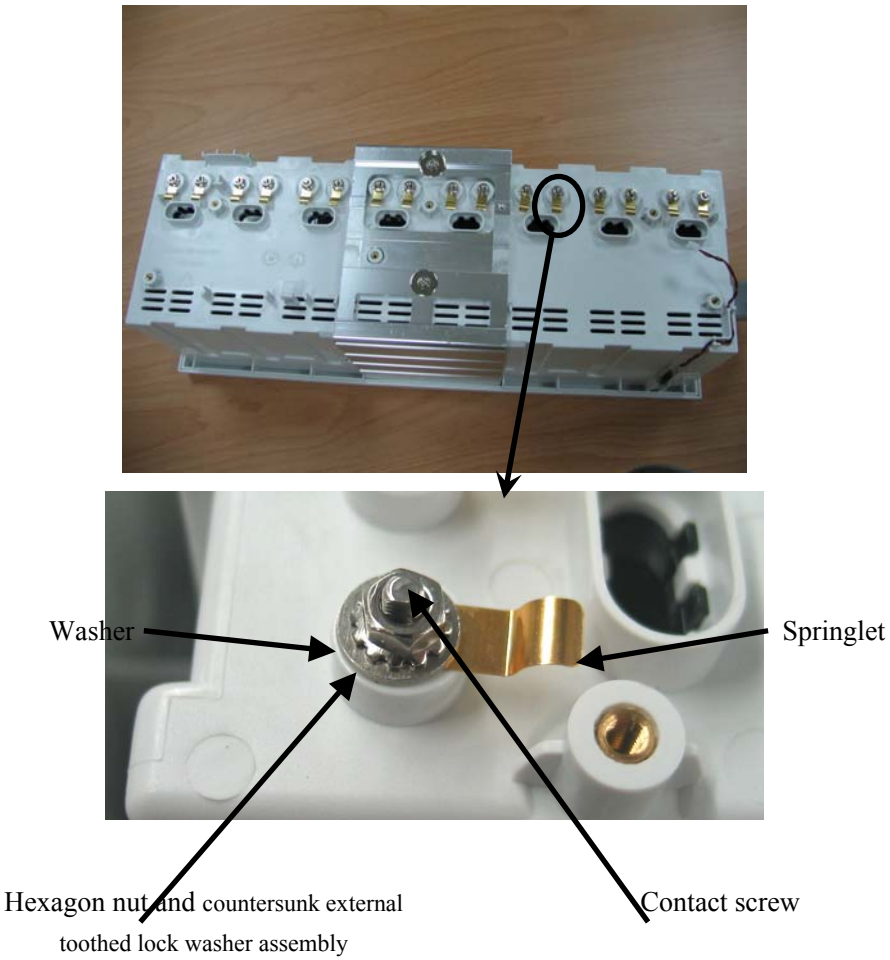
5. Remove the cable that connects the 8-slot communication board and the LED board, the LED indicator and the light tube.



6. Unclench the clips and take out the Nios II module. Then unscrew the six M3×6 screws and remove the 8-slot module rack communication board.



7. Use the sleeve to unscrew the hexagon nut and countersunk external toothed lock washer assembly which can be further separated into the washer, springlet and contact screw.



5.6 Disassembling Modules

⚠WARNING

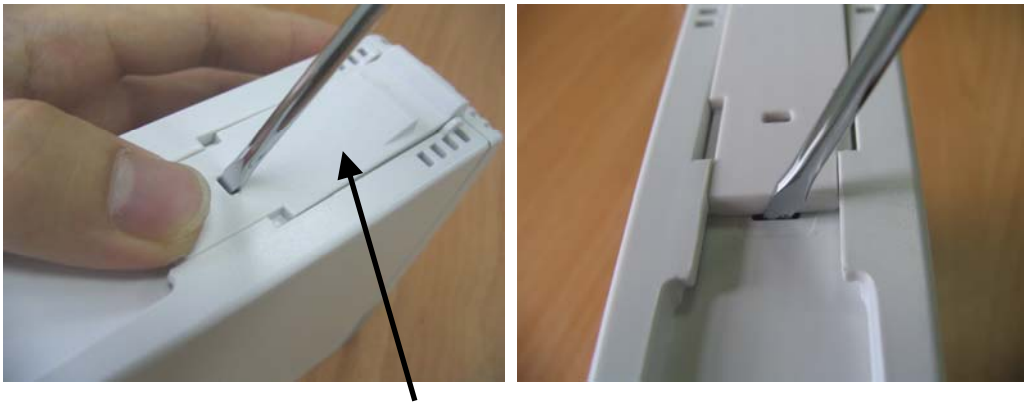
- **For a reassembled module, a patient leakage current test must be performed before it is used again for patient monitoring.**
- **Make sure the monitor is off before disassembling the modules.**

The monitor supports three types of modules, single-slot modules, 2-slot modules and 3-slot modules. The following part describes two typical disassembling procedures.

5.6.1 Disassembling the ICG Module

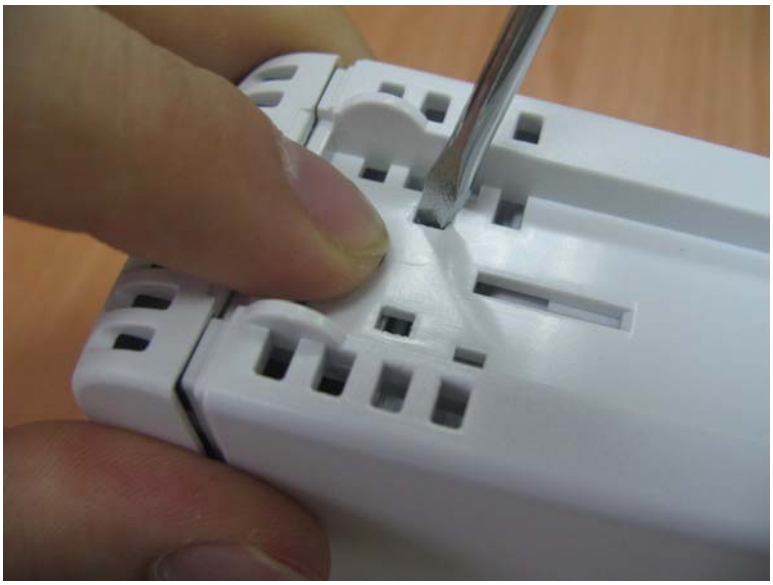
1. Unscrew the two contact screws and Φ3 spring washer on the back with a dedicated contact spanner.

2. Move the snap lock in front of the contact spanner to the unlocking position. Insert a small flat-bladed screwdriver into the hole on the snap lock and press the snap down about 1mm. At the same time, push the snap lock forwards with a thumb until the snap lock and its counterpart separate. Then release the snap lock with a screwdriver.

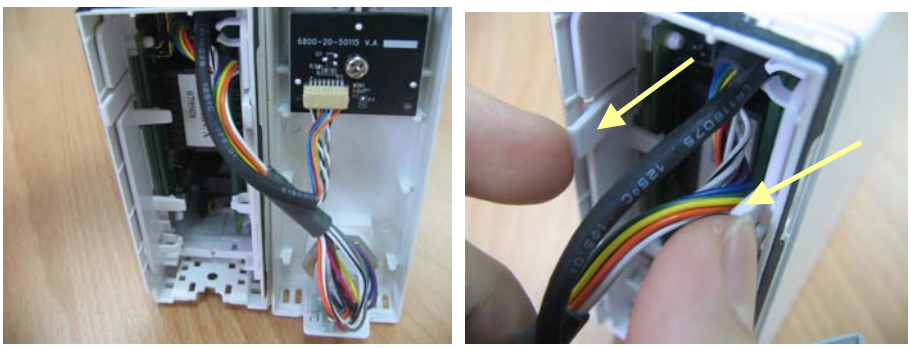


Snap Lock

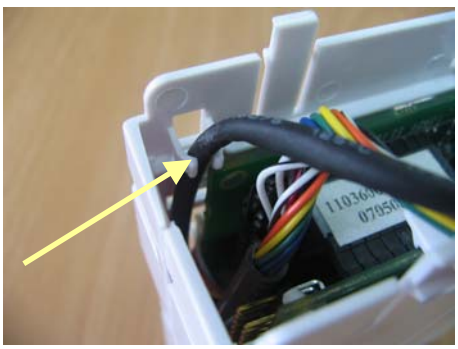
3. Unscrew the M3×6 screw. Then press down, in turn, the two clips that engage the front cover. At the same time, pull off the front cover carefully to avoid damaging the cables.

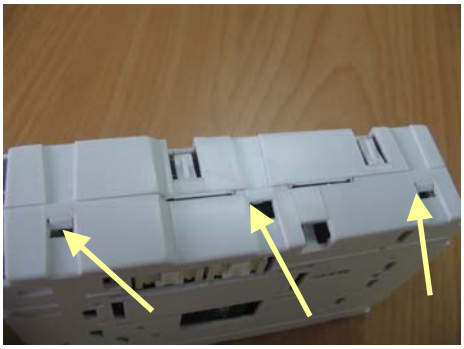


4. Press the two clips about 1mm and take off the housing.



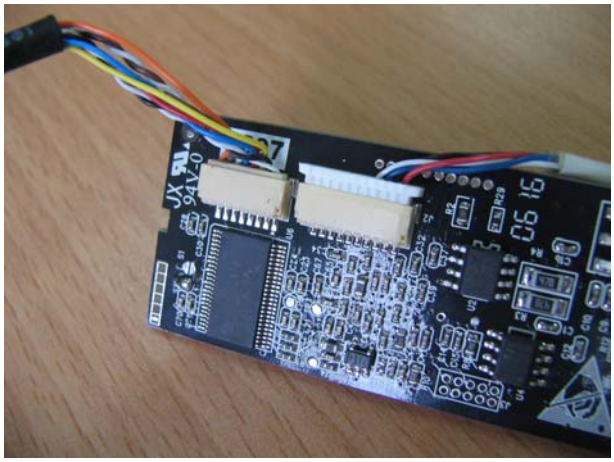
5. The side cover of the module without the housing is composed of two halves. Release the three snaps to separate the two halves.



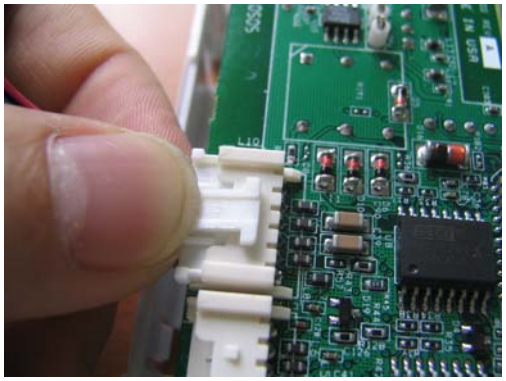


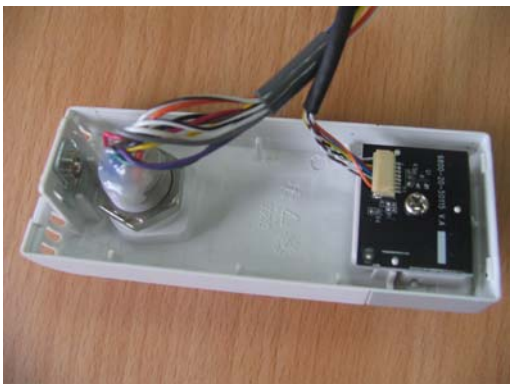
6. Take out the non-insulated power board and disconnect all the cables from it.

7. Take out the infrared communication board and disconnect all the cables from it.



8. Disconnect all the cables on the ICG board and take off it with the front cover.

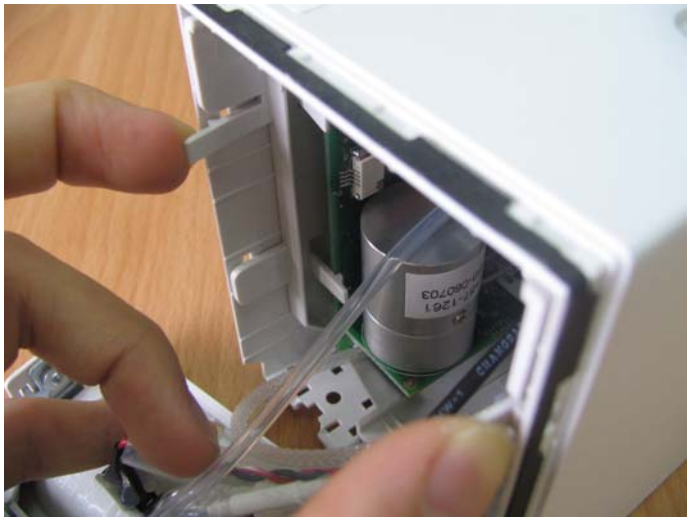


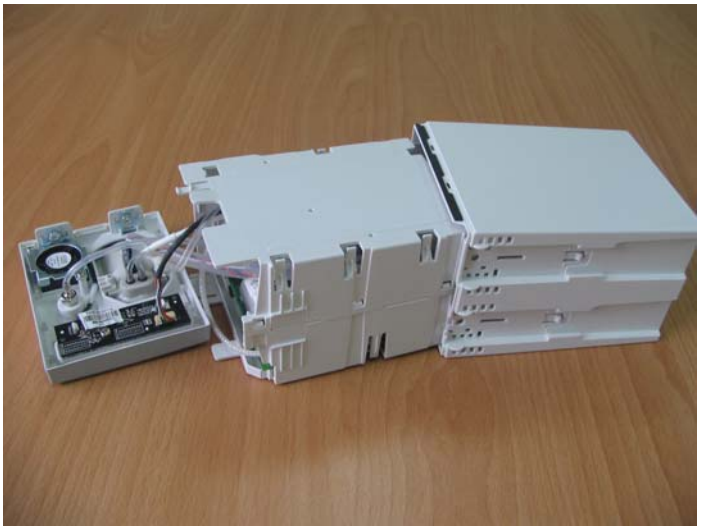


5.6.2 Disassembling CO_2 Module

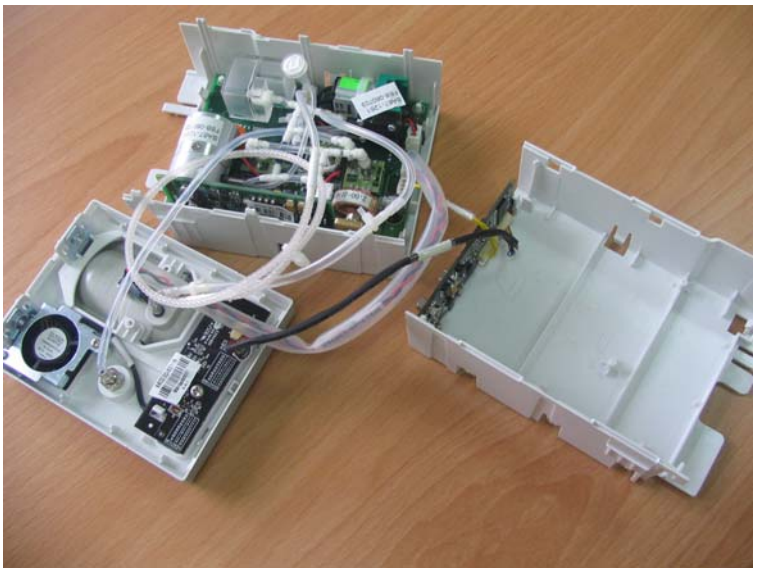
1. Remove the four contact screws on the back and two snap locks on the bottom and then unscrew the two M3×6 screws by referring to the procedure as described in 5.6.1 Disassembling the ICG Module .

2. Take off the front cover of the CO_2 module by referring to the procedure as described in 5.6.1 Disassembling the ICG Module. Then press the two clips about 1mm and take off the housing.



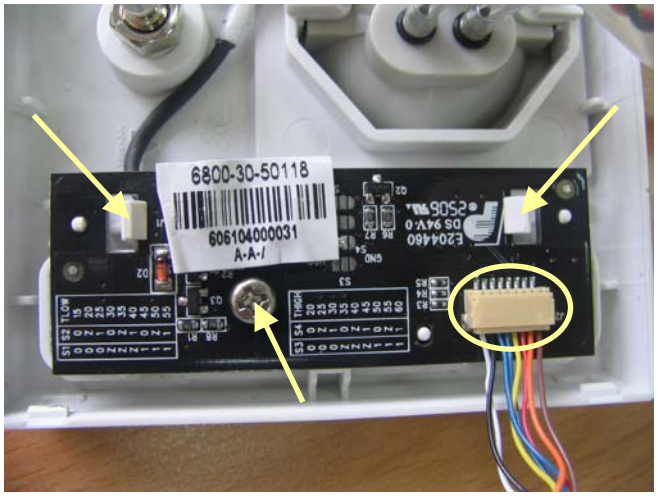


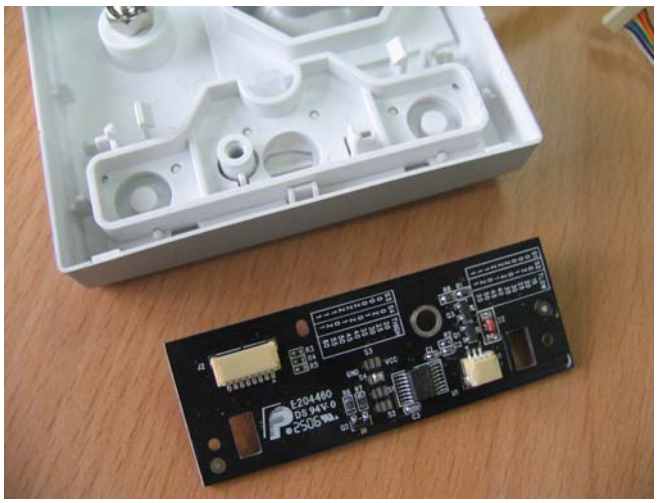
3. Hold the housing with both hands. Press the snap side with the thumb and move the other side with the index finger and the middle finger to separate the housing into two halves.



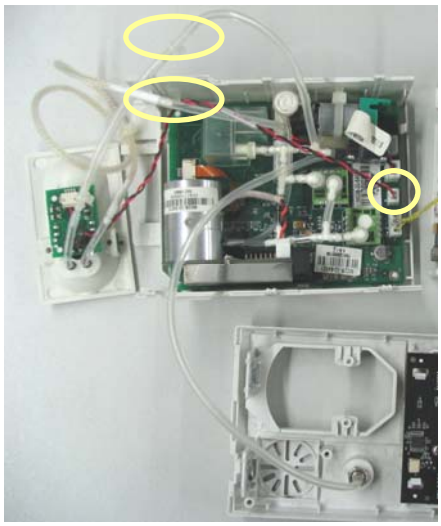
4. Take out the infrared communication board and disconnect all the cables from it.

5. Disconnect the cables from the button board and unscrew the PT3×8 screw. Then release the two clips and take out the board. After that, disconnect the cable to the fan and remove the button board.

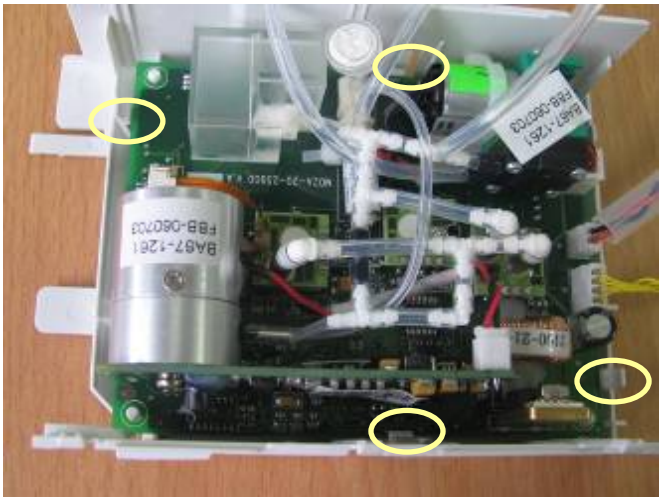


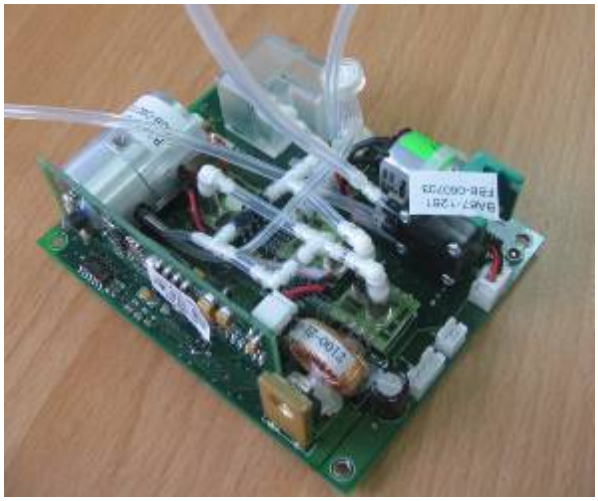


6. Unscrew the two screws on the front panel. Disconnect the tubing between the watertrap assembly and CO_2 parameter board. Disconnect the cable between the watertrap and CO_2 parameter board. Then take out the watertrap connector assembly.



7. Disconnect the tubing between the CO_2 parameter board and the front panel. Then release the four clips and remove the CO_2 parameter board.





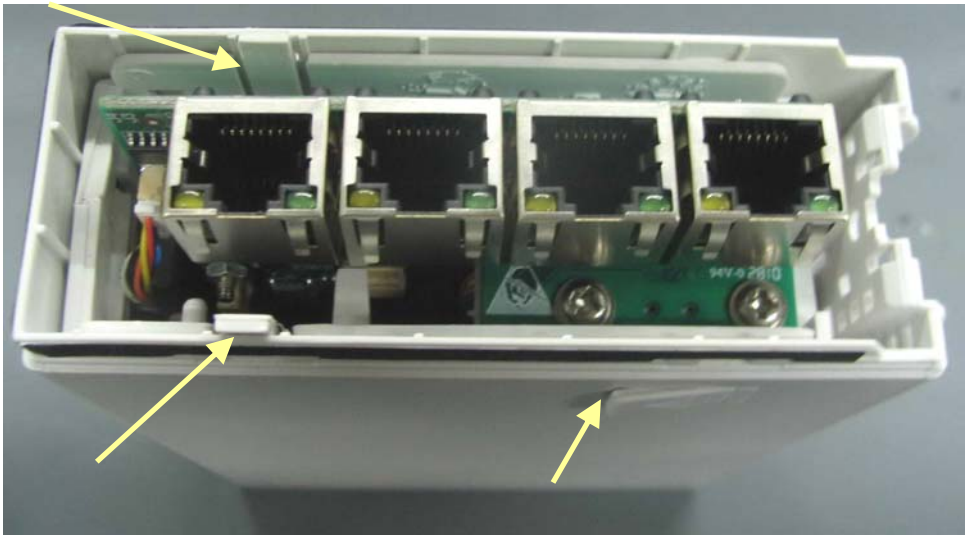
NOTE

- **When reinstalling, do not fold the tubings.**

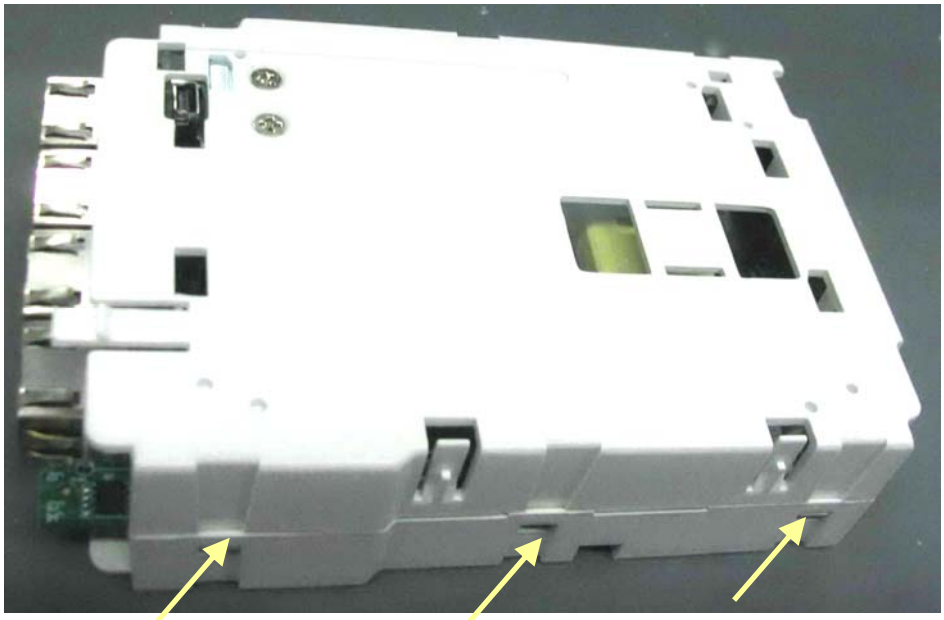
5.6.3 Disassembling the BeneLink Module

Remove the contact screws, the spanner, and the front cover by referring to steps 1 to 3 as described in ***5.6.1Disassembling the ICG Module*** .

2. Take off the small cover board on one side of the rear cover. Then press the two clips about 1mm and take off the housing.



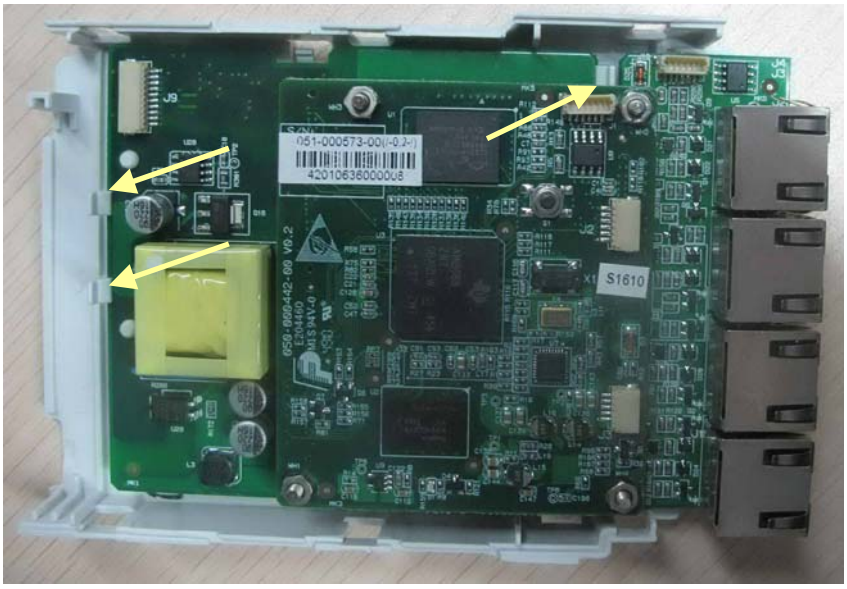
3. Release the three snaps to separate the two halves of the module side cover.



Take off the cable between the USB board and the interface board.

5. Take off the cable between the infrared communication board and the interface board to remove the infrared board.

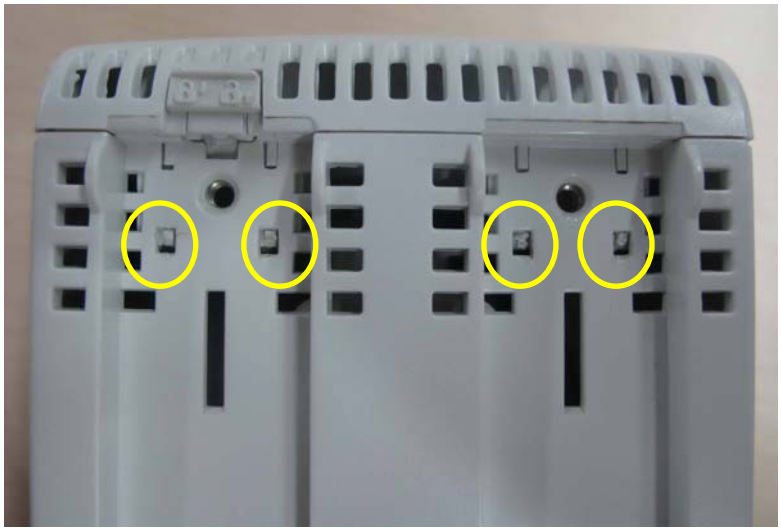
6. Unclench the four clips with a tweezer to remove the interface board.

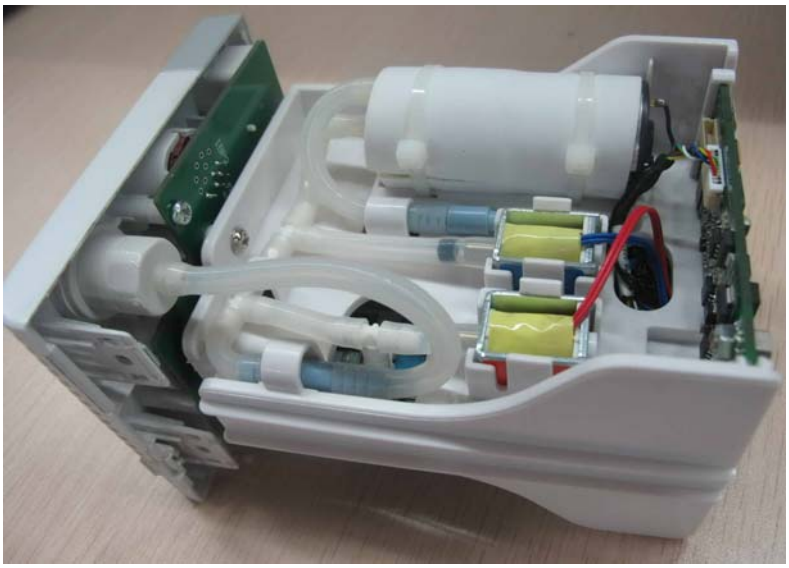


5.6.4 Disassembling the New MPM Module

1. Remove the contact screws and the spanner by referring to steps 1 to 3 as described in ***5.6.1 Disassembling the ICG Module*** .

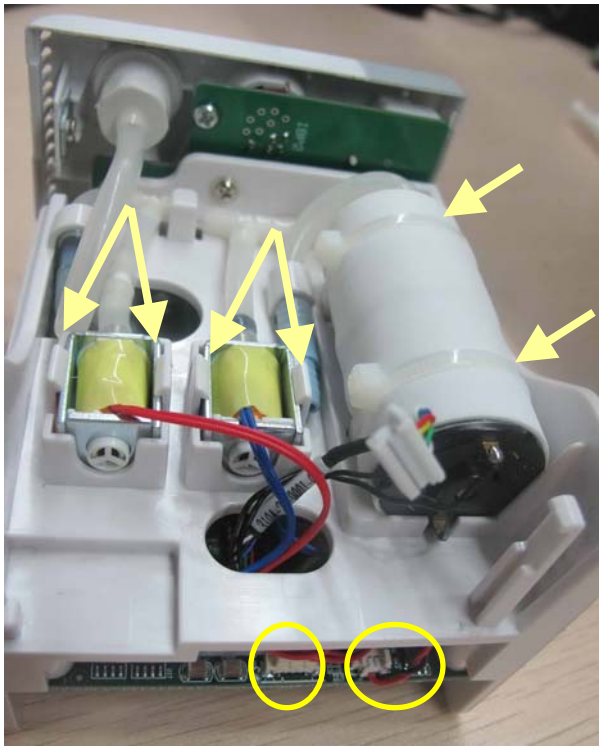
2. Unscrew the two M3×6 screws. Then press down, in turn, the four clips that engage the front cover with a small flat-bladed screwdriver. At the same time, pull off the rear cover.



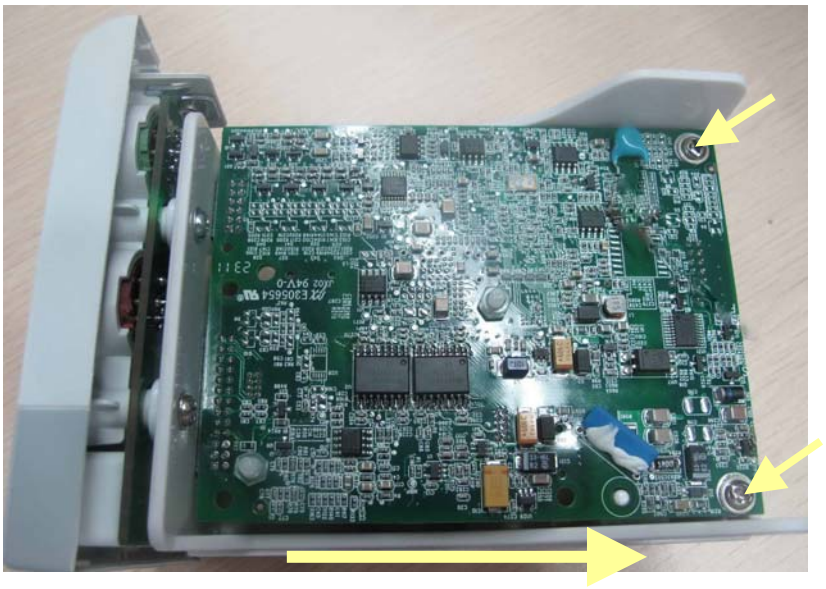


3. Disconnect the cable of the infrared communication board, and release the snap lock to remove the infrared communication board.

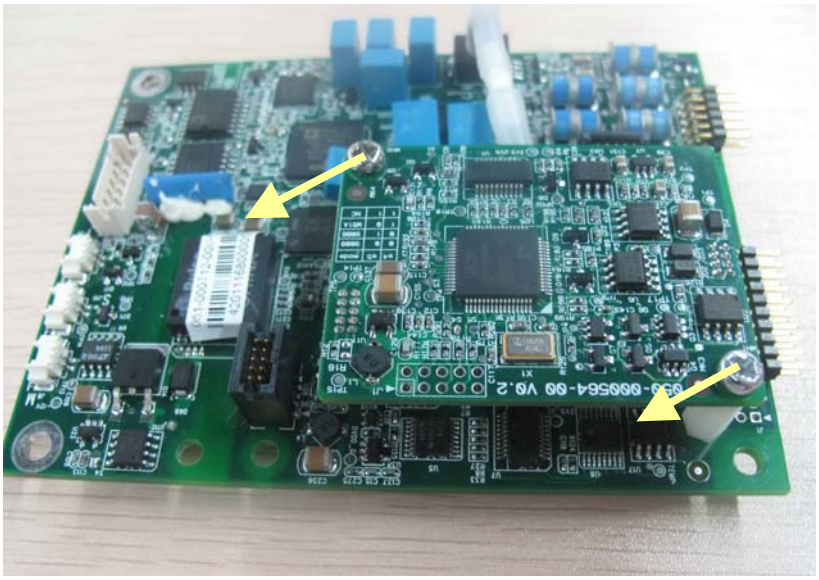
4. Disconnect the cables of the NIBP inflation pump and the relief valves from the parameter board. Snip off the cable ties to remove the pump. Release the snap locks to remove the valves.



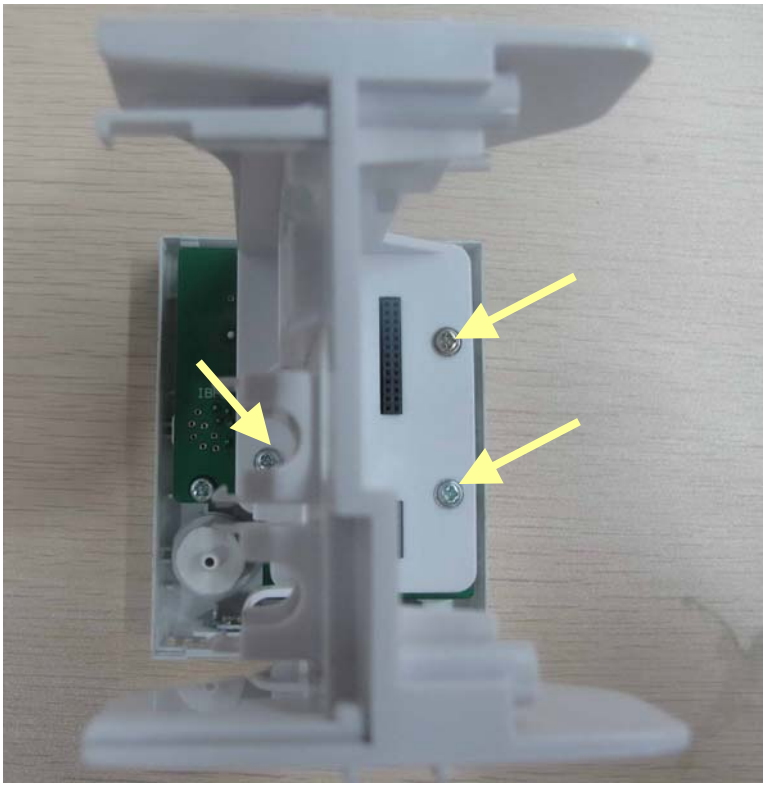
5. Unscrew the two M3×8 screws on the parameter board. Then pull off the parameter board rightward as shown below.



6. Unscrew the two M3×4 screws on the SpO_2 board to separate the SpO_2 board and the parameter board.



7. Unscrew the three M3×8 screws to separate the front panel assembly and the holder.

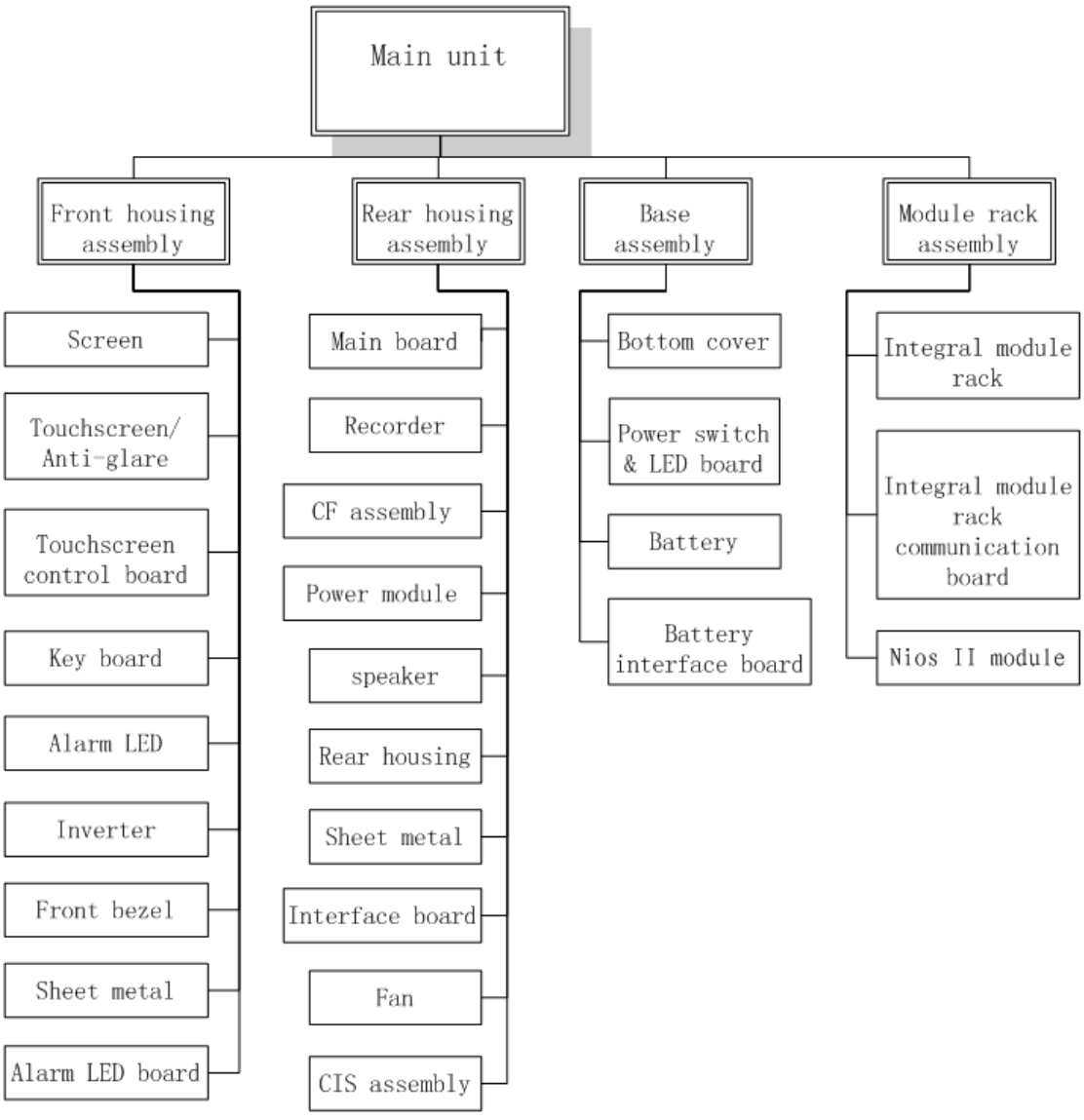


6 Parts

6.1 Introduction

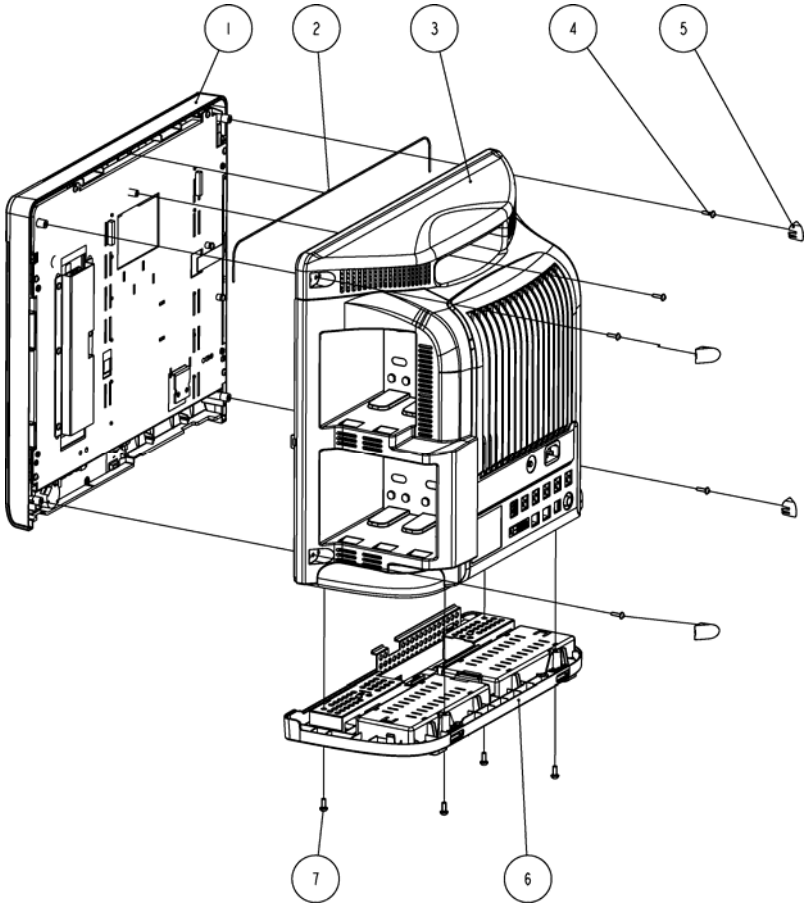
This section contains the exploded views and parts lists of the main unit, satellite module rack and parameter modules of the patient monitor. It helps the engineer to identify the parts during disassembling the patient monitor and replacing the parts.

Hardware architecture of the main unit is shown below:



6.2 Main Unit

Exploded View

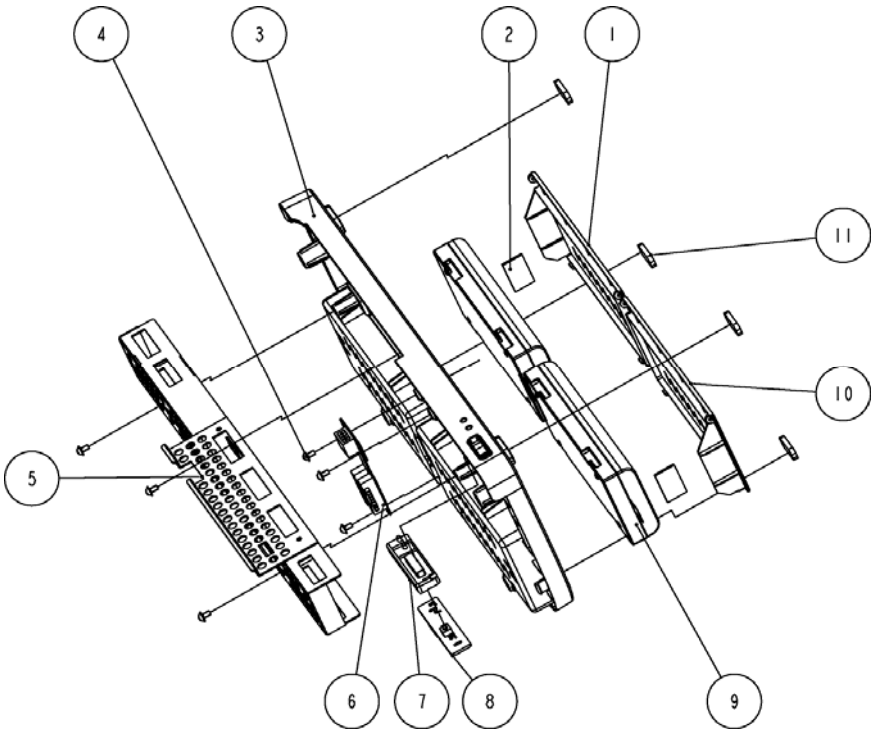


Parts List

SN	P/N	Description	Qty
1	6800-30-50479 or 6800-30-50480	Front housing assembly （17" LCD, anti-glare screen） Front housing assembly（17" LCD, touchscreen）	1
2	M6G-020015---	Hose, 0.47 m	1
3	6800-30-50473	Rear housing assembly	1
4	M04-004017---	Crosshead screw M3×12	5
5	6800-20-50189	Screw cap	4
6	6800-20-50468	Base assembly	1
7	M04-051001---	Screw, M4×12	4

6.3 Base Assembly

Exploded View



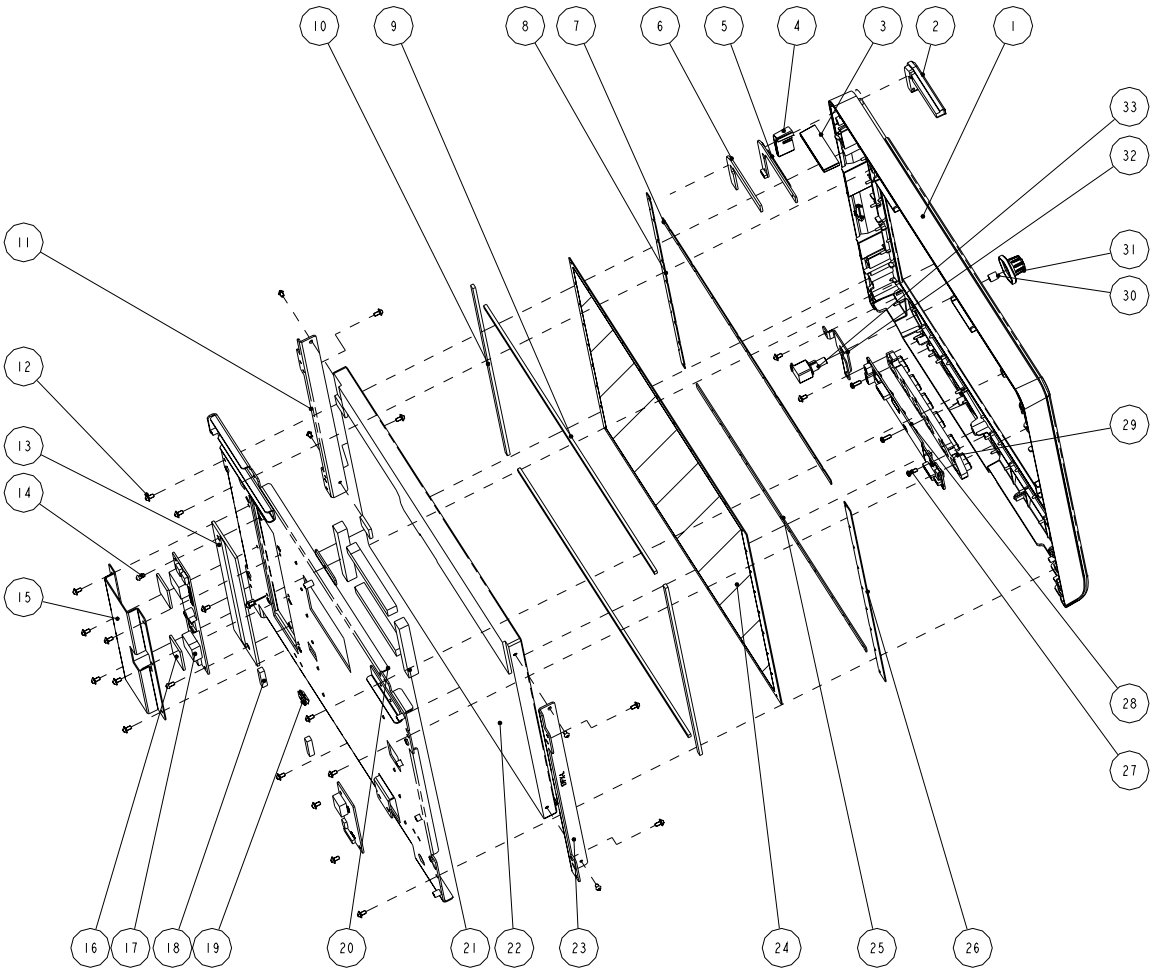
Parts List

SN	P/N	Description	Qty
1	6800-20-50183	Battery cover L	1
2	6800-20-50386	Battery cover spacer	2
3	6800-20-50181-51	Bottom cover (T8)	1
4	M04-004012---	Crosshead screw M3×6	6
5	6800-20-50212	Base support	1
6	6800-30-50108	Battery interface board	1
7	6800-20-50201-51	Power switch (T8)	1
8	6800-30-50088	Power switch board	1
9	M05-010002-06	Lithium battery, 1.1 V, 4500 mAh	2
10	6800-20-50182	Battery cover L	1
11	6800-20-50233	Cushion	4

6.4 Front housing Assembly

6.4.1 17” LCD with Anti-glare Screen

Exploded View



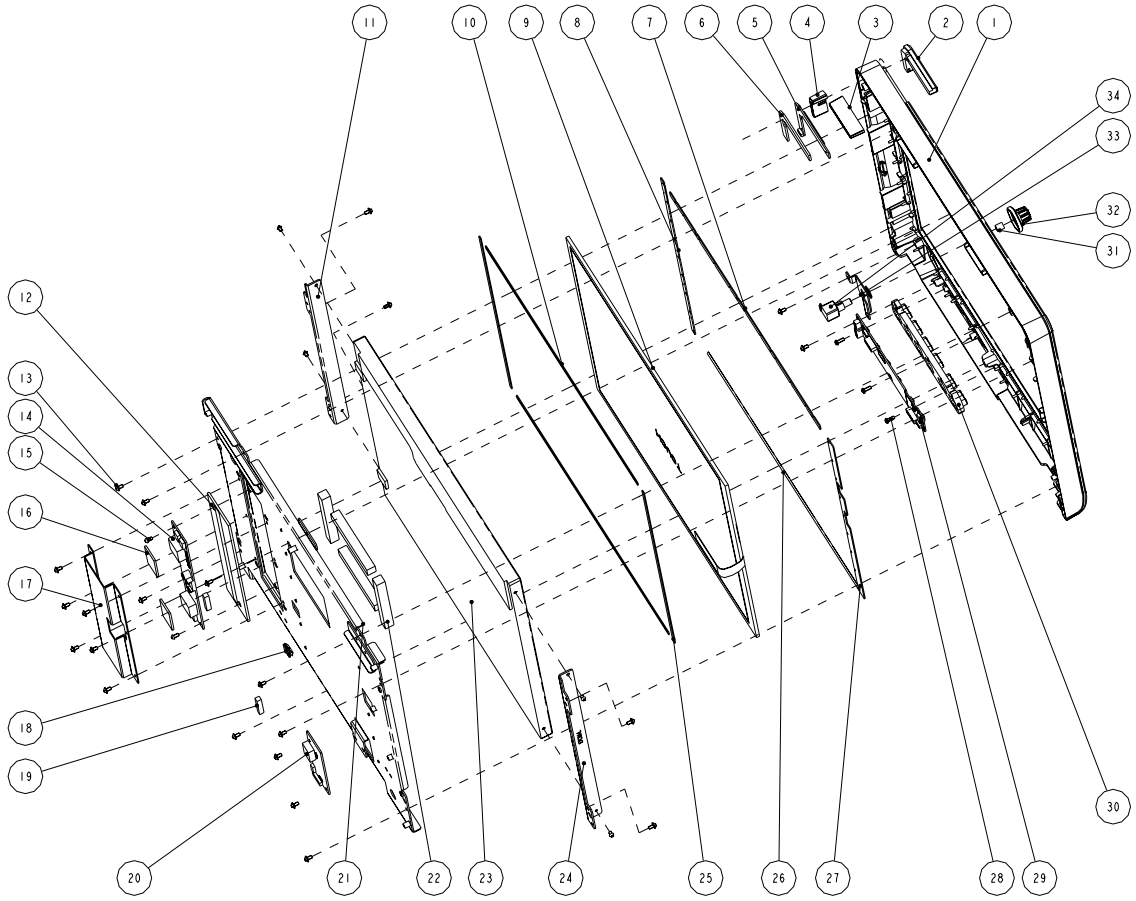
Parts List

SN	P/N	Description	Qty
1	043-000484-00	Front housing (T8)	1
2	6800-20-50199	Alarm LED cover	1
3	6800-20-50390	Light conduction block 2	1
4	6800-20-50389	Light conduction block 1	1

5	6800-30-50086	Indicator board	1
6	6800-20-50691	Insulating strip for alarm LED board	1
7	6800-20-50220	PC cusion 1	1
8	6800-20-50221	PC cusion 2	1
9	6800-20-50228	Dust-proof pad 7	2
10	6800-20-50227	Dust-proof pad 6	2
11	6800-20-50207	Screen support 4(for 17” anit-glare screen)	1
12	M04-004012---	Crosshead screw M3×6	22
13	6800-20-50232	Backlight board insulating sheet	1
14	M04-002505---	Crosshead screw M3×6	2
15	6800-20-50671	Backlight board shielded cover	1
16	6800-20-50692	Backlight board insulating sheet	2
17	0000-10-11072	Converter DC-AC12VDC/700Vrms	1
18	9901-10-23920	Conducting foam 0501080	0.8
19	0000-10-10996	Leaf 92-047	1
20	042-000575-00	Screen mounting plate	1
21	M6T-030003---	Conducting foam, 4105AB51K	4
22	021-000043-00 or 0000-10-11069 (optional)	17”LCD screen	1
23	6800-20-50206	Screen support 3(for 17” anit-glare screen)	1
24	6800-20-50336	Anti-glare screen	1
25	6800-20-50392	PC cusion 4	1
26	6800-20-50391	PC cusion 3	1
27	M04-003105---	Tapping screw PT3×8	3
28	115-001326-01	T8 button board (anti-glare/optical encoder) (without shank)	1
29	6800-20-50198	Silicon buttons	1
30	M6T-040001---	Clamp spring.1707P	1
31	0651-20-76735	Knob (mould MR76734)	1
32	042-000693-00	Knob mounting plate	1
33	0000-10-10789	Optical Encoder 16 steps 5VDC Dip6	1

6.4.2 17” LCD Touchscreen

Exploded View



Parts List

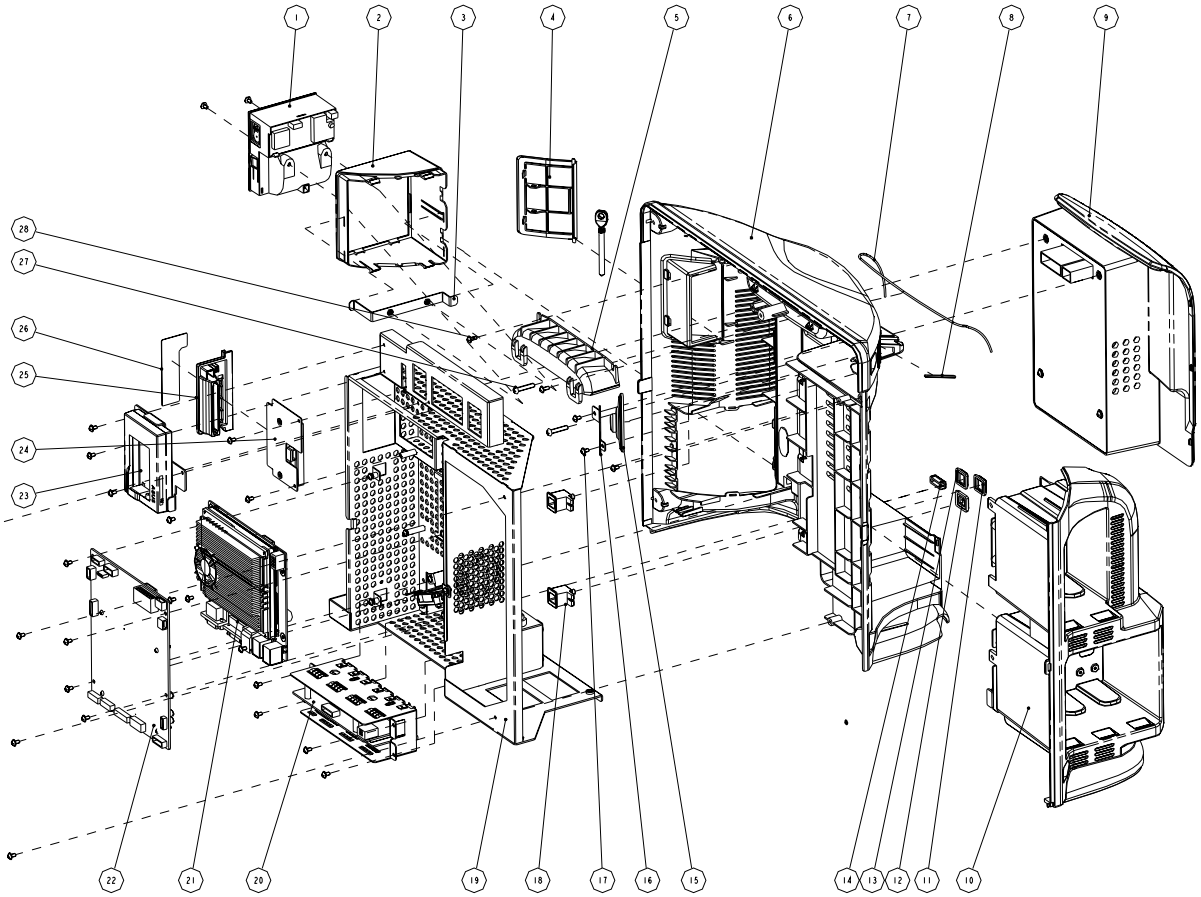
SN	P/N	Description	Qty
1	043-000484-00	Front bezel (T8)	1
2	6800-20-50199	Alarm LED cover	1
3	6800-20-50390	Light conducting block2	1
4	6800-20-50389	Light conducting block1	1
5	6800-30-50086	Indicator board	1
6	6800-20-50691	Insulating strip for alarm LED board	1
7	6800-20-50222	Dust-proof pad 1	1

8	6800-20-50223	Dust-proof pad 2	1
9	0000-10-11071 or 0000-10-10748 (optional)	Touchscreen, resistance, 17.1″	1
10	6800-20-50226	Dust-proof pad 5	2
11	6800-20-50205	Screen support 2(for 17” touchscreen)	1
12	6800-20-50232	Backlight board	1
13	M04-004012---	Crosshead screw M3×6	22
14	0000-10-11072	Backlight board	1
15	M04-002505---	Crosshead screw M3×6	2
16	6800-20-50692	Backlight board insulating sheet	2
17	6800-20-50671	Backlight board shield	1
18	0000-10-10996	Berylium-bronze leaf 92-047	1
19	9901-10-23920	Conducting foam0501080	2
20	6800-30-50082 or 6800-30-51095 (optional)	Touchscreen control board （6800-30-51095 only used together with the optional touchscreen 0000-10-10748）	1
21	042-000575-00	Screen mounting plate	1
22	M6T-030003---	Conducting foam, 4105AB51K	4
23	021-000043-00 or 0000-10-11069 (optional)	LCD screen	1
24	6800-20-50204	Screen support 1(for 17’ touchscreen)	1
25	6800-20-50225	Dust-proof pad 4	2
26	6800-20-50224	Dust-proof pad 3	1
27	6800-20-50142	Touchscreen waterproof strip	1
28	M04-003105---	Tapping screw PT3×8	3
29	115-004216-00	T8 button board (touchscreen/optical encoder) (without shank)	1
30	6800-20-50198	Silicon buttons	1
31	M6T-040001---	Clamp spring.1707P	1
32	0651-20-76735	Knob (mould MR76734)	1
33	042-000693-00	Knob mounting plate	1
34	0000-10-10789	Optical Encoder 16 steps 5VDC Dip6	1

6.5 Rear Housing Assembly

6.5.1 Rear Housing Assembly

Exploded View



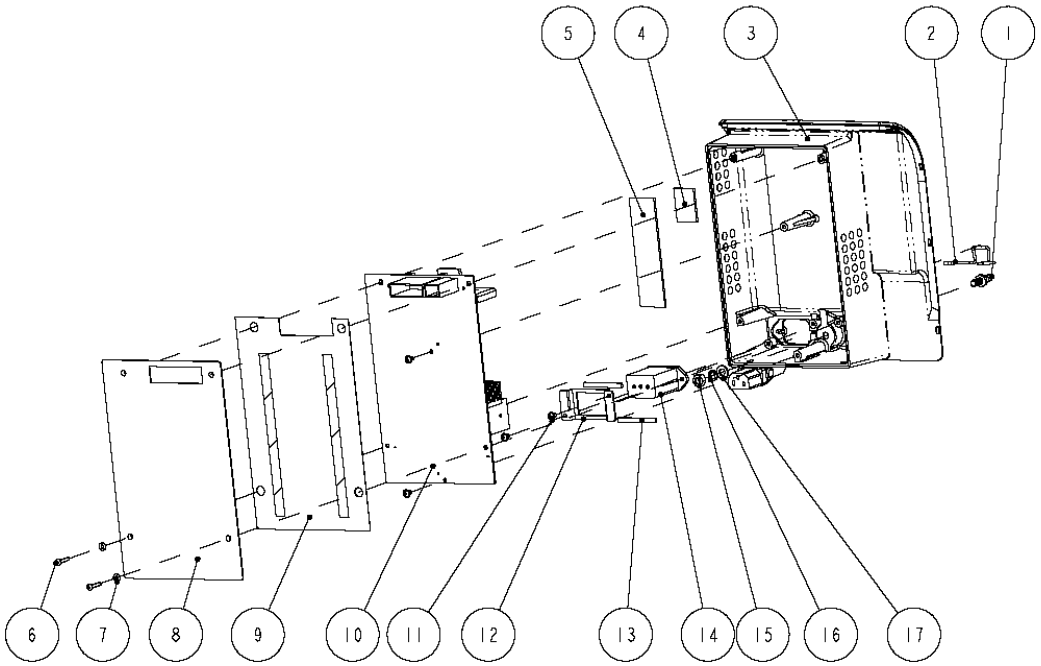
Parts List

SN	P/N	Description	Qty
1	TR6F-30-67306	TR6F recorder	1
2	6800-20-50193	Recorder chamber	1
3	6800-20-50213	Recorder support rack	1
4	6800-20-50196	CF card door	1
5	6800-20-50185	Handle cover	1

6	043-000060-00	Rear housing (new connector)	1
7	M6G-020015---	Hose, 0.3m	1
8	6800-20-50234	Waterproof strip I	1
9	6800-30-50475	Power module assembly	1
10	6800-30-50469	Module rack (maximum configuration)	1
11	043-000561-00	Grey USB cover	1
12	043-000471-00	CIS network port cover	1
13	043-000470-00	USB cover	1
14	043-000469-00	MiniDB9 cover (T8)	1
15	6200-21-11629	Speaker	1
16	6800-20-50195	Speaker pad	1
17	M04-004012---	Crosshead screw M3×6	27
18	6800-20-50187	plug	2
19	6800-30-50533 or 115-003226-00	Main support assembly	1
20	6800-30-50476 or 115-003227-00	Interface board assembly	1
21	6800-30-50474	CIS assembly	1
22	6800-30-50532 or 115-003232-00	Main board assembly	1
23	115-003225-00	6800 internal wireless AP assembly	1
24	115-001868-00	6800 CF card assembly (9211 driving board)	1
25	6800-20-50395	WLAN tray	1
26	6800-20-50143	WLAN overlay	1
27	M04-051054---	Crosshead screw M4×20	2
28	M04-004015---	Crosshead screw M3×8	2

6.5.2 Power module

Exploded View

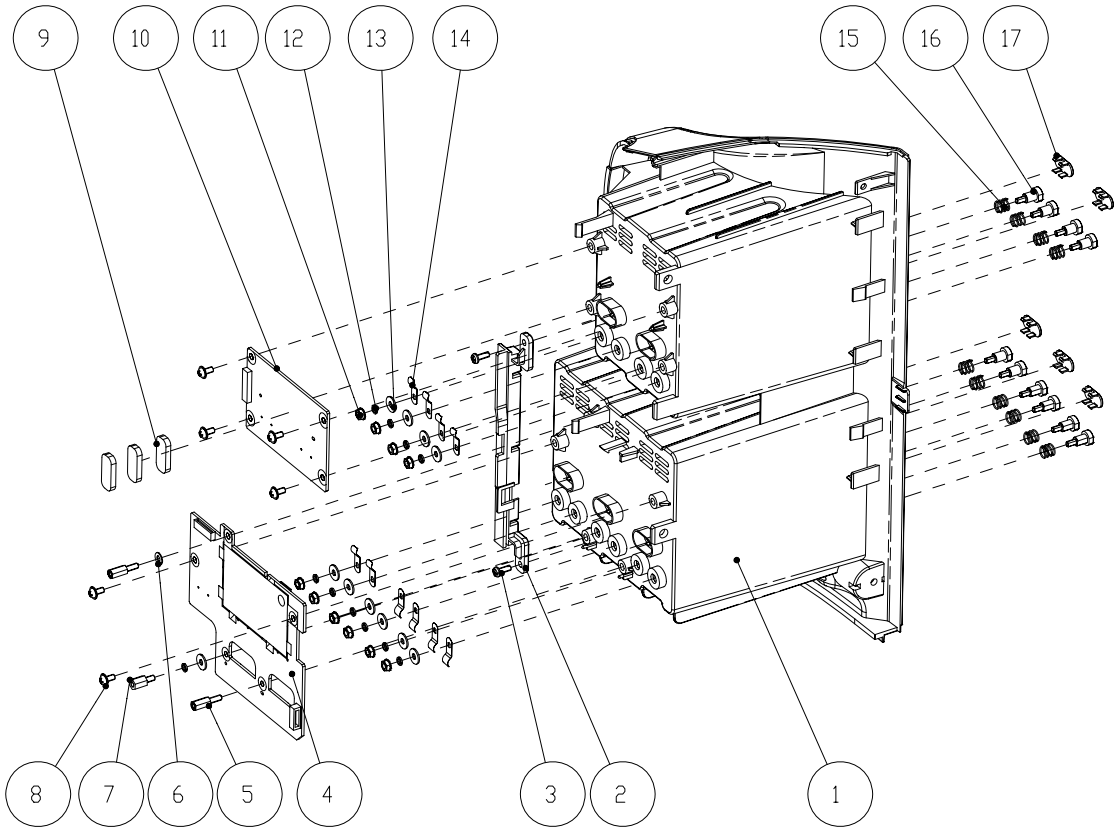


Parts List

SN	P/N	Description	Qty
1	0509-20-00098	Grounding terminal	1
2	9211-20-87369	Pothook for power supply plugs	1
3	6800-20-50197-51	Power module chamber (T8)	1
4	6800-20-50692	Backlight board insulating sheet	1
5	6800-20-50693	Backlight board insulating plate I, 100×27 mm	1
6	M04-004017---	Philips pan head screw GB9074.5-88 M3×12	2
7	M04-021024---	Large washer class A GB/T96.1-2002 3	2
8	6800-20-50219	Sheet metal	1
9	6800-20-50465	Power board insulating sheet	1
10	6800-30-50050 or 051-000193-00	6800 power board 6800 power board PCBA (No voltage decrease, 5V CIS power board)	1
11	M04-004012---	Crosshead screw M3×6	4
12	6800-20-50218	power socket fixture	1
13	6800-20-50636	Waterproof strip for power socket	2
14	009-000255-00	AC input connector and cable	1
15	M04-004401---	Stainless steel nut, hexagon GB/T6170-2000 M6 polished	1
16	M04-004504---	Spring washer	1
17	M04-021003---	Flat washer	1

6.5.3 Integral Module Rack

Exploded View



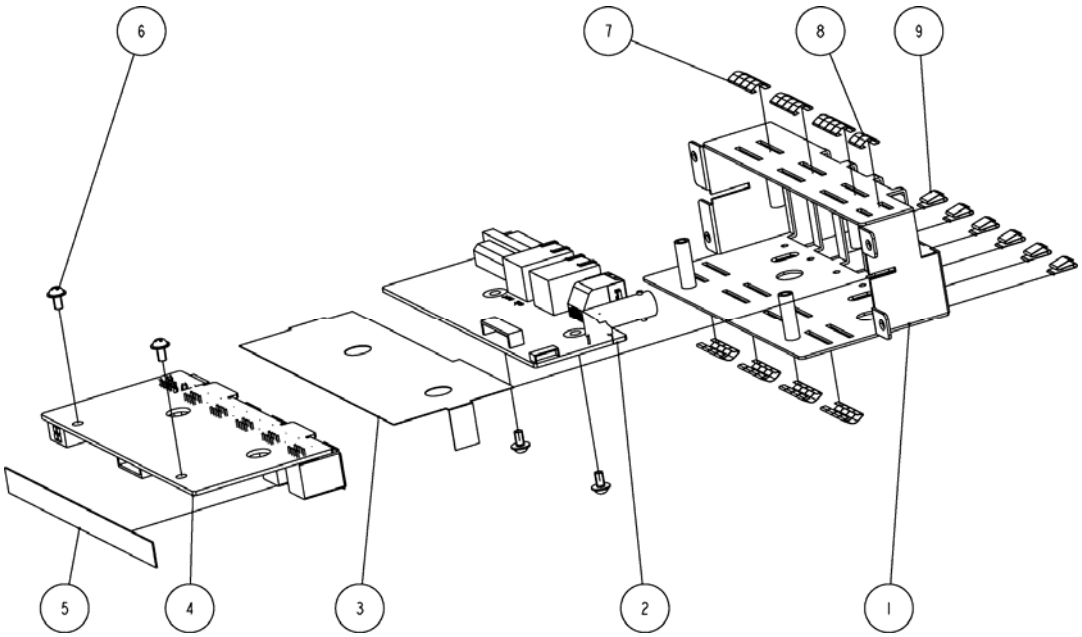
Parts List

SN	P/N	Description	Qty
1	6800-20-50190	Side plate, rear housing-ALL	1
2	6800-20-50191	Side plate small cover, rear housing -ALL	1
3	M04-003105---	Tapping screw PT3×8	2
4	051-000243-00	6800 three-slot module rack communication board	1
5	M04-000306---	stud screw M3X10+8-8, coated with antirust nickel	2
6	M04-021024---	Large Flat Washer, GB96 3	1
7	M04-030035---	plastic stud screw M3X8+6-6	1
8	M04-004012---	Philips pan head screw M3×6	6
9	6800-20-50233	Rubber feet	3

10	6800-30-50073	MPM module rack communication board	1
11	M04-000301---	Stainless steel hexagon nut GB/T6170-2000 M3 polished	10
12	M04-000802---	Flat washer-grade A GB/T97.1-20023 nickel plated to resist rust	11
13	M04-000104---	Standard spring washerGB/T93-1987 3 nickel plated to resist rust	11
14	6800-20-50388	Leaf	10
15	6800-20-50261	Contact spring	10
16	6800-21-51100	Contact screw	10
17	6800-20-50279	Infrared lens	5

6.5.4 Interface Board Assembly

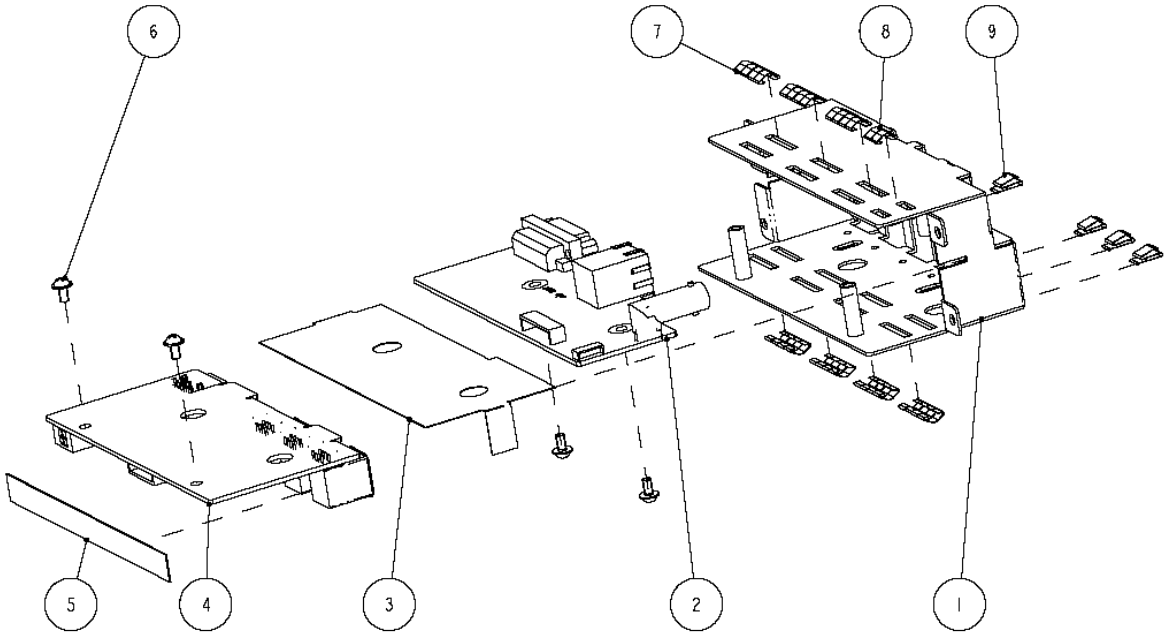
Exploded View (6800-30-50476)



Parts List

SN	P/N	Description	Qty
1	042-000055-00	T8 interface support (new interface)	1
2	051-000221-00	6800 DVI interface board (full configuration)	1
3	6800-20-50241	Interface board insulating plate	1
4	051-000222-00	6800 USB interface board (full configuration)	1
5	6800-20-50745	Waterproof strip	1
6	M04-004012---	Screw, M3×6	4
7	M6T-030005---	Berilium & bronze leaf 187S30（4 leaves）	7
8	M6T-030005---	Berilium & bronze leaf 187S30（2 leaves）	1
9	M6T-030006---	Berilium & bronze leaf 92-106 nickel plated	6

Exploded View (115-003227-00)



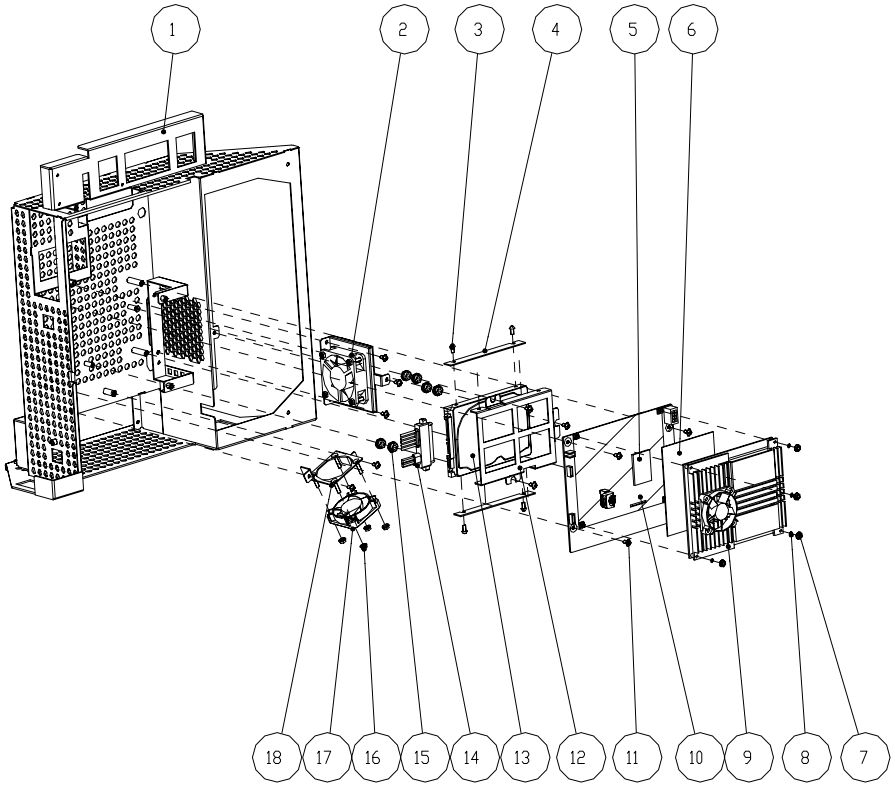
Parts List

SN	P/N	Description	Qty
1	042-000055-00	T8 interface support (new interface)	1
2	051-000221-01	6800 DVI interface board (standard configuration)	1
3	6800-20-50241	Interface board insulating plate	1
4	051-000222-01	6800 USB interface board (standard configuration)	1
5	6800-20-50745	Waterproof strip	1

6	M04-004012---	Screw, M3×6	4
7	M6T-030005---	Berilium & bronze leaf 187S30	7
8	M6T-030005---	Berilium & bronze leaf 187S30	1
9	M6T-030006---	Berilium & bronze leaf 92-106 , nickel plated	6

6.5.5 Main Support Assembly

Exploded View

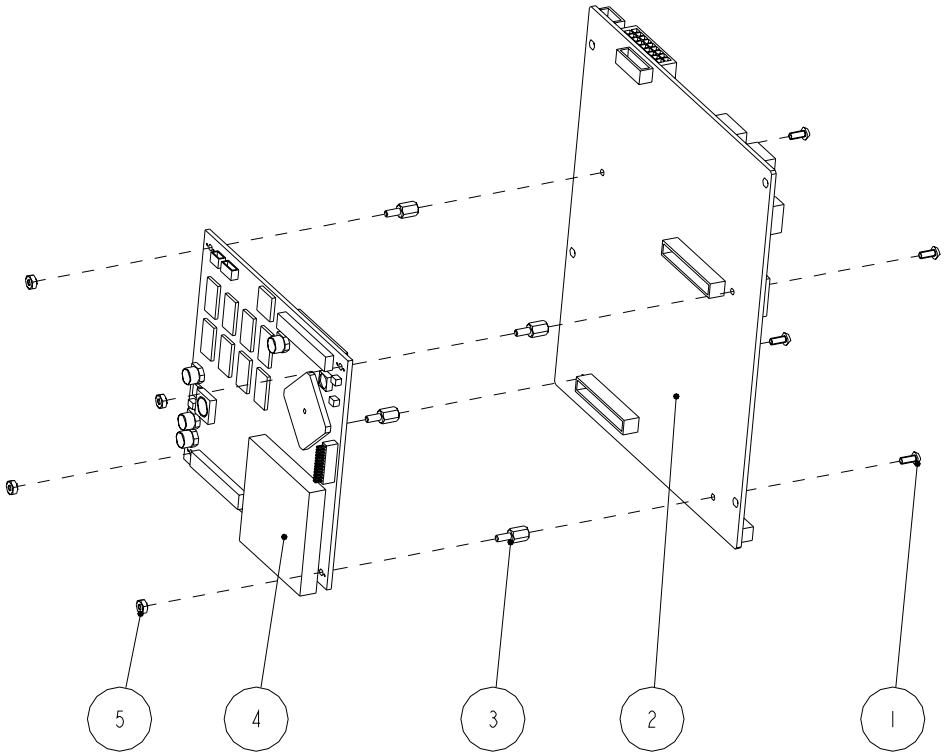


Parts List

SN	P/N	Description	Qty
1	6800-20-50215	Main support	1
2	6800-30-50509	Fan assembly	1
3	M04-002505---	Pan head screw, M3×6	4
4	047-007081-00	Damping washer	2
5	6800-20-50692	Heat-conductive insulator	1
6	045-000201-00	CIS hard disk heat conductive glue (T8 SATA, HD)	1
7	M04-011001---	Hexagon nut	4
8	M04-021002---	Standard spring washer	4
9	023-000418-00	Industrial control board	
10	051-000381-00	6800 CIS mother board	1
11	M04-004012---	Pan head screw with washer, M3×6	12
12	042-001493-01	CIS hard disk bracket(T8 SATA HD)	1
13	023-000416-00	Hard disk, 320GB, 2.5inch, SATA	1
14	009-000856-00	Hard disk signal wire (SATA, HD)	
15	3001-10-06985	Volume measuring fixing washer	6
16	M04-011002---	M3 nut with spring washer	4
17	M90-000170---	FAN 12V 8.0CFM 32dBA 40*40*10mm	1
18	6800-20-50147	CIS fan support rack	1

6.5.6 Main Control Board Assembly

Exploded View

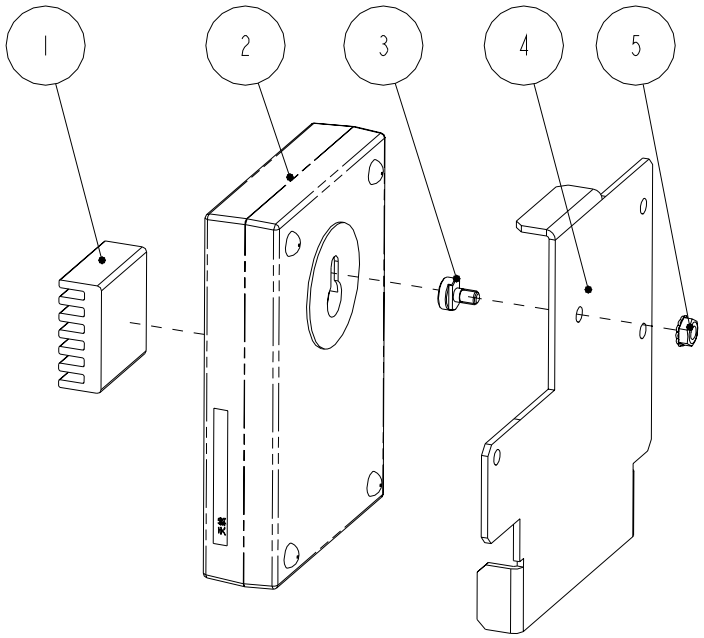


Parts List

SN	P/N	Description	Qty
1	M04-051045---	Cross head screw M2.5X6	4
2	051-000220-00 or 051-000220-01	6800 mother board (full configuration) 6800 mother board (standard configuration)	1
3	M04-060021---	Stud M2.5x7+6-6	4
4	6800-30-50058	MCF547x CPU module (basic configuration/lead-free)	1
5	M04-011001---	Nut GB6170 M2.5	4

6.5.7 6800 Internal Wireless AP Assembly

Exploded View



Parts List

SN	P/N	Description	Qty
1	045-000196-00	Chip radiator	1
2	0000-10-10777	Wireless AP	1
3	9211-20-87346	Wireless AP mounting screw	1
4	042-000599-00	T8 wireless AP mounting support	1
5	M04-011002---	Hex nut assy M3	2

6.5.8 Others

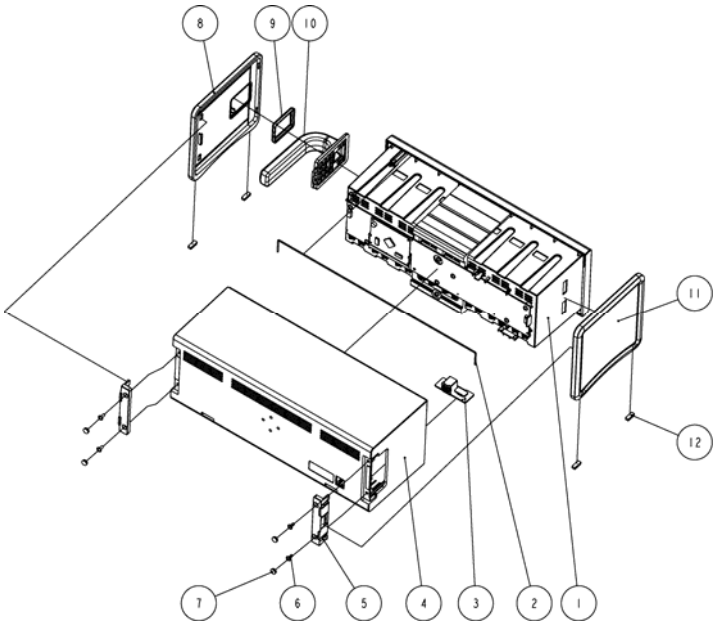
P/N	Description	Qty
CIS assembly －6800-30-50474		
0000-10-11201	Memory bank	1
0000-10-11202	Hard disk	1
3003-20-35008	Rubber washe	6
0000-10-10755	Control board	1
6800-20-50304	Ethernet cable for DVI interface board	1
6800-20-50333	CIS board flat cable	1

6800-20-50387	CIS hard disk insulating plate	1
6800-20-50550	CIS hard disk support	1
6800-20-50690	Hard disk signal wir	1
6800-20-50692	Backlight board thermo-conductive insulating plate	1
6800-20-50700	Heat conducting block for CIS hard disk	1
6800-30-50112	CIS mother board	1
M04-004012---	Crosshead screw	3
M04-051045-00	Stainless steel crosshead screw	4
M05-100R29-02	Lithium button cell battery, 3V 220mAh D20*3.2	1
TR6F recorder – TR6F-30-67306		
0000-10-11079	Thermal print head	1
9201-20-36007	Grounding wire	1
M04-051003---	Crosshead tapping screw PT2X6	6
TR6F-20-67300	Recorder chamber	1
TR6F-20-67301	Recorder door	1
TR6F-20-67302	Spanner	1
TR6F-20-67303	Internal adapter	1
TR6F-20-67304	Back spring	1
TR6F-20-67305	Silicon button	1
TR6F-20-67307	Overlay	1
TR6F-20-67314	Cable from recorder drive board to recorder button board	1
TR6F-30-67308	Recorder button board	1
TR6F-30-67310	Recorder drive board	1

6.6 SMR Assembly

6.6.1 SMR Assembly

Exploded View

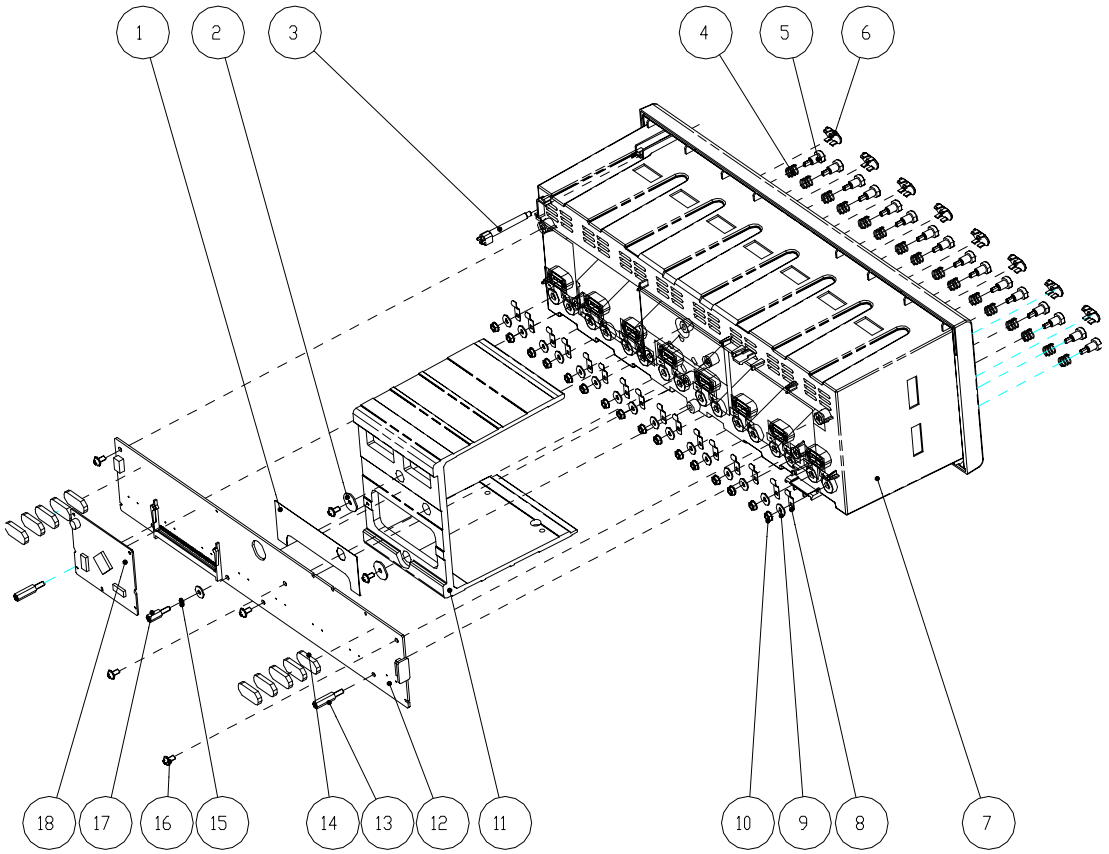


Parts List

SN	P/N	Description	Qty
1	6800-20-50249-51	Inside assembly	1
2	M6G-020015---	Hose	1
3	6800-30-51154	Interface board	1
4	6800-20-50250	Rear housing	1
5	6800-20-50254	Side plate fixture	2
6	M04-004015---	Crosshead screw M3×8	4
7	6800-20-50308	Screw cap 2	4
8	6800-20-50253	Side plate, right	1
9	6800-20-50262	Rubber washer	1
10	6800-20-50251	Handle	1
11	6800-20-50252	Side plate, left	1
12	6800-20-50263	Cushion	4

6.6.2 SMR Inside Assembly

Exploded View



Parts List

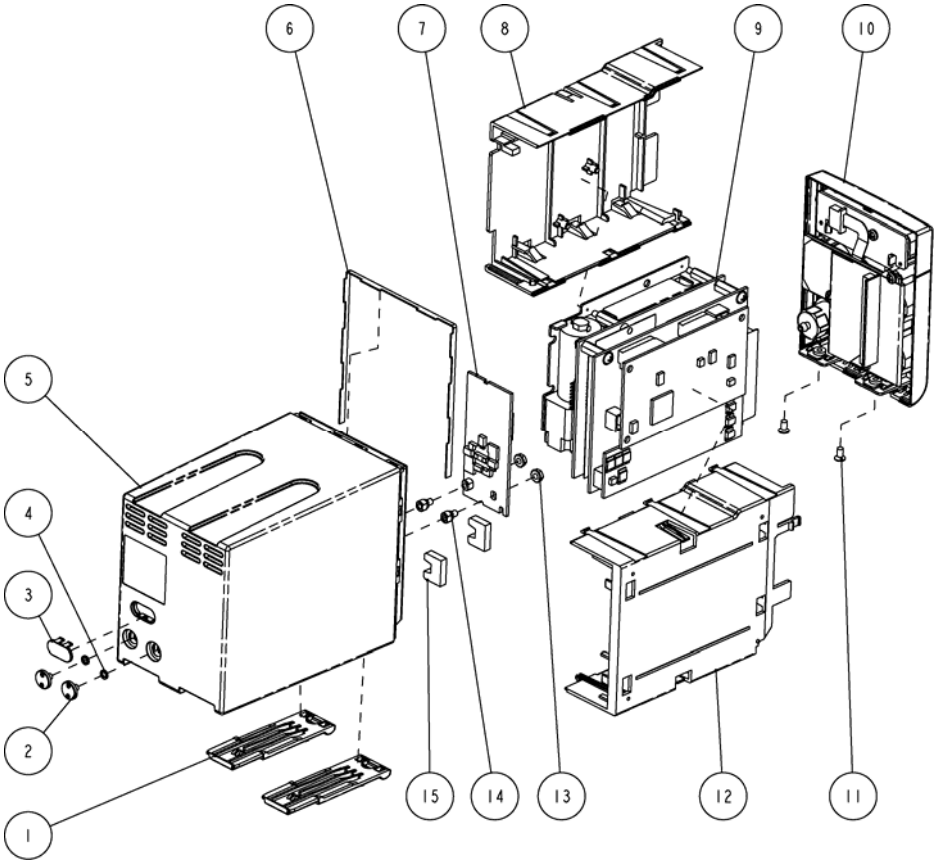
SN	P/N	Description	Qty
1	6800-20-50519	Insulating plate	1
2	9201-20-36010	Torsion spring washer	2
3	6800-20-50256	Light conducting pole	1
4	6800-20-50261	Contact spring	16
5	6800-21-51100	Contact screw	16
6	6800-20-50279	Infrared light filter	8
7	6800-20-50249	SMR inside assembly	1
8	6800-20-50388	Leaf	16
9	M04-021024---	Washer	16
10	M04-011002---	Hex nut assy	16
11	6800-20-50257-51	Reinforced section steel	1

12	6800-30-51153	8-slot module rack communication board	1
13	M04-004306---	stub screw M3X16+8-8	2
14	6800-20-50233	Rubber feet	10
15	M04-000104---	spring washer GB93 3	1
16	M04-004012---	Crosshead screw M3×6	6
17	M04-000306---	stud screw M3X10+8-8, coated with antirust nickel	1
18	6800-30-50075	Nios II module	1

6.7 Parameter Modules

6.7.1 MPM Module

Exploded View



Parts List

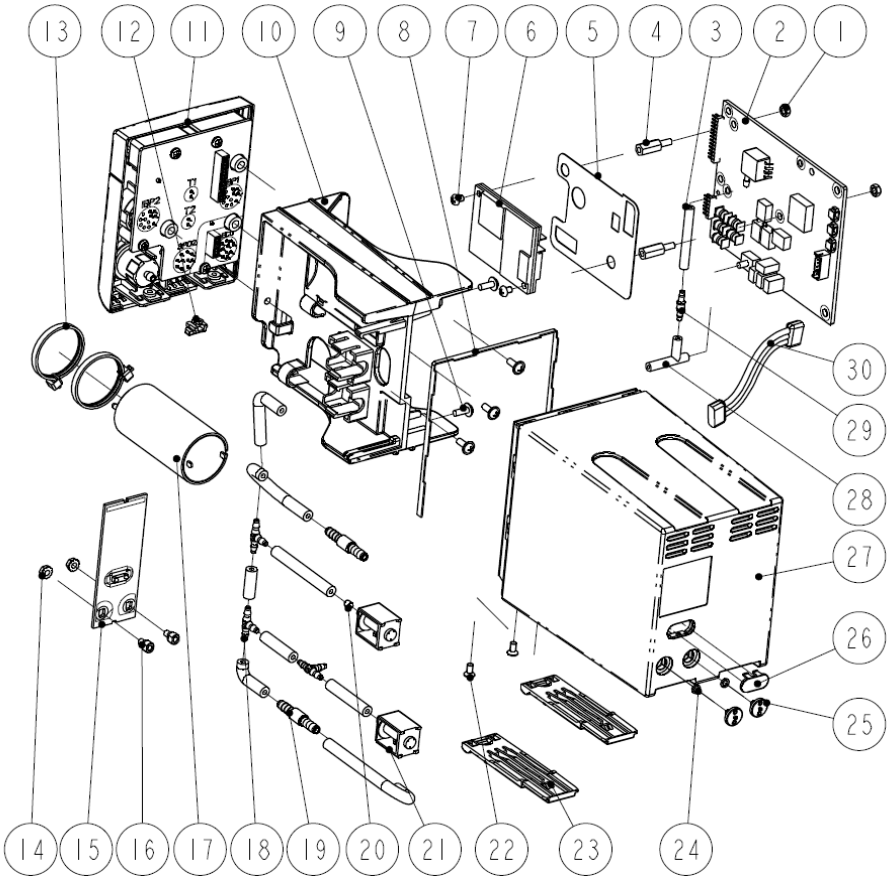
SN	P/N	Description	Qty
1	6800-20-50278	Spanner	2
2	6800-20-50293	Screw	2

3	6800-20-50279	Infrared light filter	1
4	M04-000104---	Spring washer	2
5	6800-20-50273	Rear cover	1
6	6800-20-50339	Waterproof seal 02	1
7	6800-30-50684	MPM module infrared communication backboard	1
8	6800-20-50275	Right cover	1
9	M51A-30-80924	NIBP&MPM analog module	1
10	M51A-30-80870	MPM front panel assembly	1
11	M04-005005---	Crosshead screw M3×6	2
12	6800-20-50274	Left cover	1
13	M04-011002---	M3 nut with spring washer	2
14	6800-20-50292	Fixer	2
15	6800-20-50870	Cushion	2

6.7.2 New MPM Module

New MPM module applies the integrative parameter board (ECG ASIC).

Exploded View



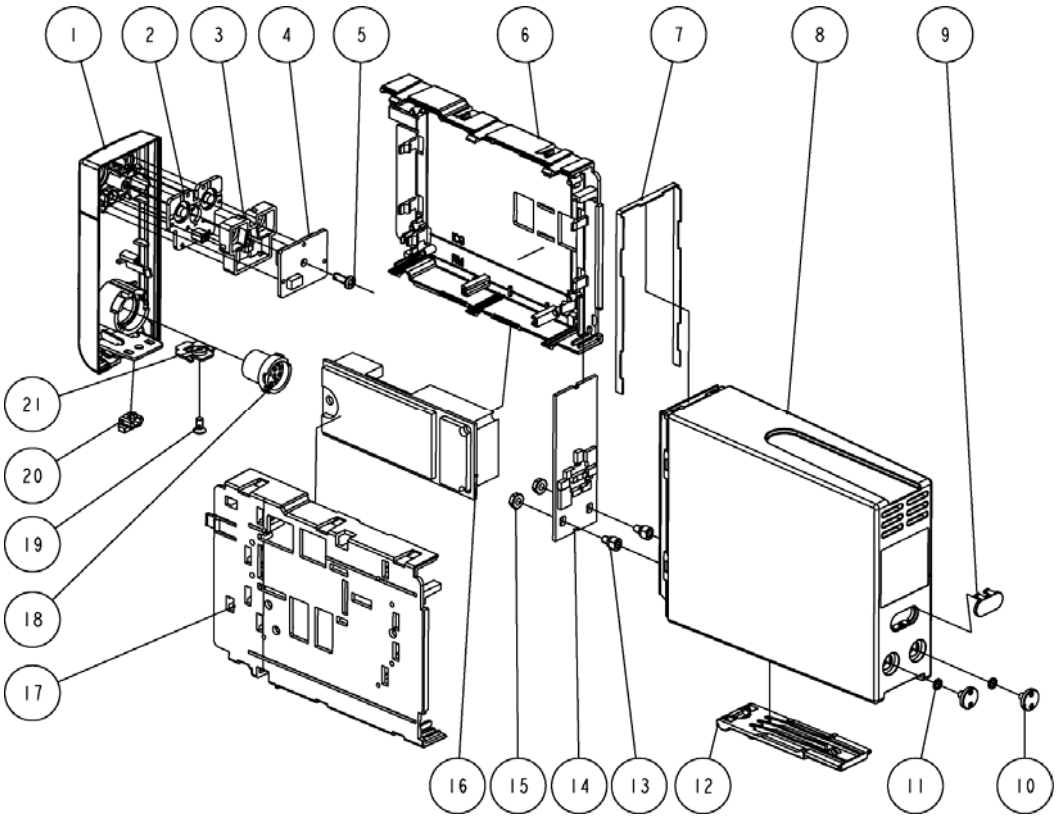
Parts List

SN	P/N	Description	Qty
1	M90-000156---	Plastic hex nut M3	2
2	051-000976-00	M51A Multi-parameter module, 5-lead, standard	1 As configured
	051-000977-00	M51A Multi-parameter module, 5-lead, full	
	051-000978-00	M51A Multi-parameter module, 12-lead, full	
	051-001037-00	M51A Multi-parameter module, 5-lead, full, IBP, Masimo	
3	A21-000007---	Silicone tube	1.65 inch
4	M90-000155---	Plastic hex stud screw, M3×12	2
5	047-006240-00	Insulation sheet for SpO_2 board	1
6	051-000943-00	9008 V2.0 SpO_2 board	1 As configured
	0671-00-0102-01	Nellcor SpO_2 board	
	040-001149-00	Masimo, MS-2013, SpO_2 board	
7	M04-051001-01	Crosshead screw M3×4	2
8	6800-20-50339	Waterproof seal 02	1
9	M04-004015---	Cross pan head screw with washer M3×8	5
10	043-001964-00	Holder	1
11	115-011209-00	New MPM front panel assembly, Midnary SpO_2	1 As configured
	115-011210-00	New MPM front panel assembly, Nellcor SpO_2	
	15-011211-00	New MPM front panel assembly, Masimo2013 SpO_2	
	115-011212-00	New MPM front panel assembly, Mindray SpO_2, no IBP	
	115-011213-00	New MPM front panel assembly, Nellcor SpO_2, no IBP	
	115-011214-00	New MPM front panel assembly, Masimo SpO_2, no IBP	
12	6800-20-50394	Snap close	1
13	A90-000031---	Cable tie, CHS-4×150mm	2
14	M04-011002---	M3 nut with washer	2
15	115-011562-00	New M51A Infrared communication board	1 As configured
	115-011563-00	New M51A Infrared communication board, no IBP	
16	6800-20-50292	Fixer	2

17	801-6800-00211-00	NIBP pump for M51A and iPM	1
18	S1-0103-00-0511	Tee connector, White, Nylon	3
19	0010-10-12408	Inline Filter	2
20	082-000098-00	630F Reducer	1
21	082-000864-00	Valve	1
22	M04-005005---	Flat head screw, Phillips M3×6	2
23	6800-20-50278	Spanner	2
24	M04-000104---	Spring Washer	2
25	6800-20-50293	Screw	2
26	6800-20-50279	Infrared light filter	1
27	6800-20-50273	Rear cover	1
28	049-000328-00	Silicone tee tube	1
29	M90-100028-01	Connector	1
30	009-002220-00	Cable for infrared Communication board	1

6.7.3 C.O. Module

Exploded View

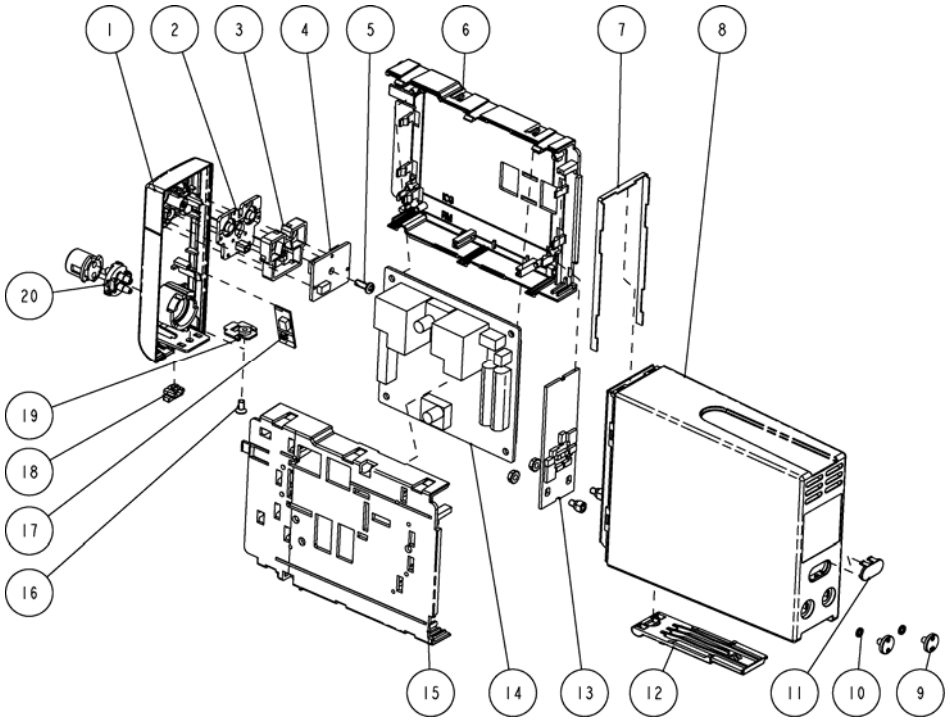


Parts List

SN	P/N	Description	Qty
1	6800-20-50264-54	Front panel (C.O./English)	1
2	6800-20-50284	Silicon button	1
3	6800-20-50282	Silicon button fixture	1
4	6800-30-50114	Button board	1
5	M04-003105---	Tapping screw PT3×8	1
6	6800-20-50269	Left cover	1
7	6800-20-50338	Waterproof seal 01	1
8	6800-20-50268	Rear cover	1
9	6800-20-50279	Infrared light filter	1
10	6800-20-50293	Screw	2
11	M04-000104---	Spring washer	2
12	6800-20-50278	Spanner	1
13	6800-20-50292	Fixer	2
14	6800-30-50798	CO module infrared communication board	1
15	M04-011002---	M3 nut with spring washer	2
16	M03B-30-26064	C.O./IBP improved board (M03B)	1
17	6800-20-50270	Right cover	1
18	9211-21-87243	C.O. connector cable	1
19	M04-005005---	Crosshead screw M3×6	1
20	6800-20-50394	Snap close	1
21	6800-20-50286	Locking device	1

6.7.3 RM Module

Exploded View



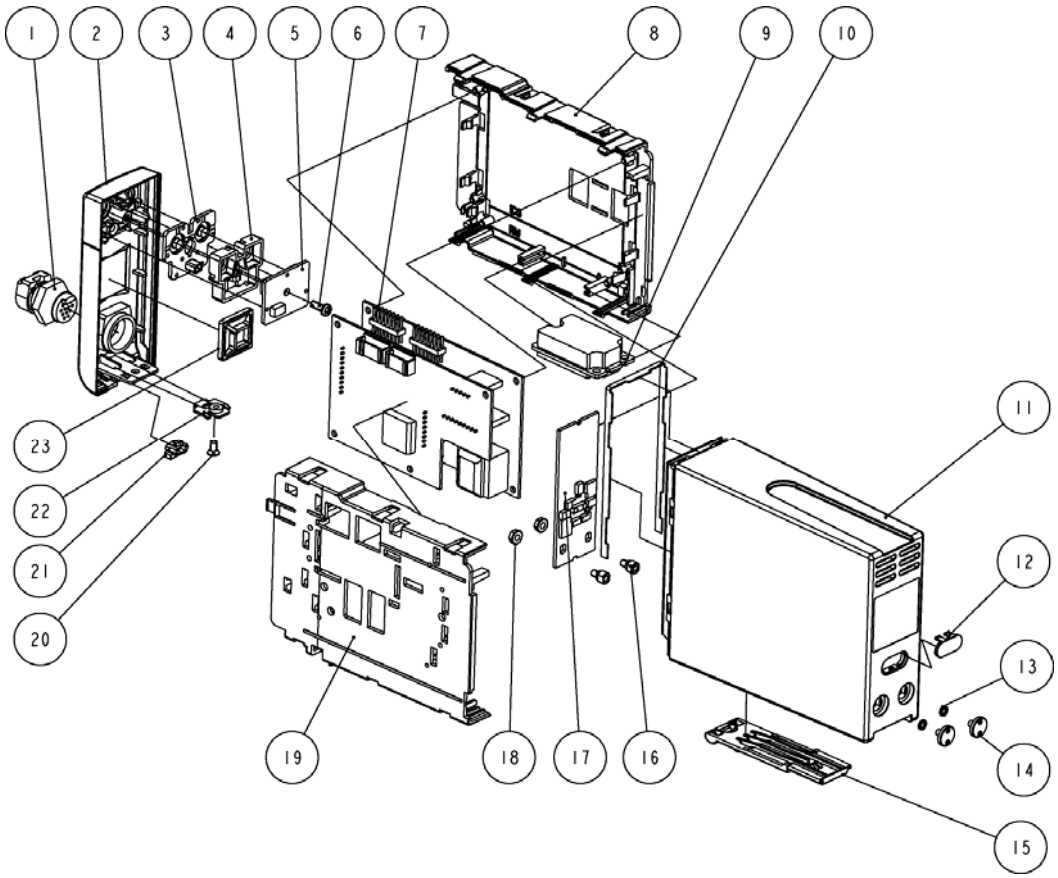
Parts List

SN	P/N	Description	Qty
1	6800-20-50264-53	Front panel (RM/English)	1
2	6800-20-50284	Silicon button	1
3	6800-20-50282	Silicon button fixture	1
4	6800-30-50114	Button board	1
5	M04-003105---	Tapping screw PT3×8	1
6	6800-20-50269	Left cover	1
7	6800-20-50338	Waterproof seal 01	1
8	6800-20-50268	rear cover	1
9	6800-20-50293	screw	2
10	M04-000104---	Spring washer	2
11	6800-20-50279	Infrared light filter	1

12	6800-20-50278	Spanner	1
13	6800-30-50812	RM module infrared communication board	1
14	M04A-30-58452	RM main unit	1
15	6800-20-50270	right cover	1
16	M04-005005---	Crosshead screw M3×6	1
17	6800-30-50152	Infrared detecting board	1
18	6800-20-50394	Snap close	1
19	6800-20-50286	Locking device	1
20	6800-30-50489	Connector assembly	1

6.7.4 ICG Module

Exploded View

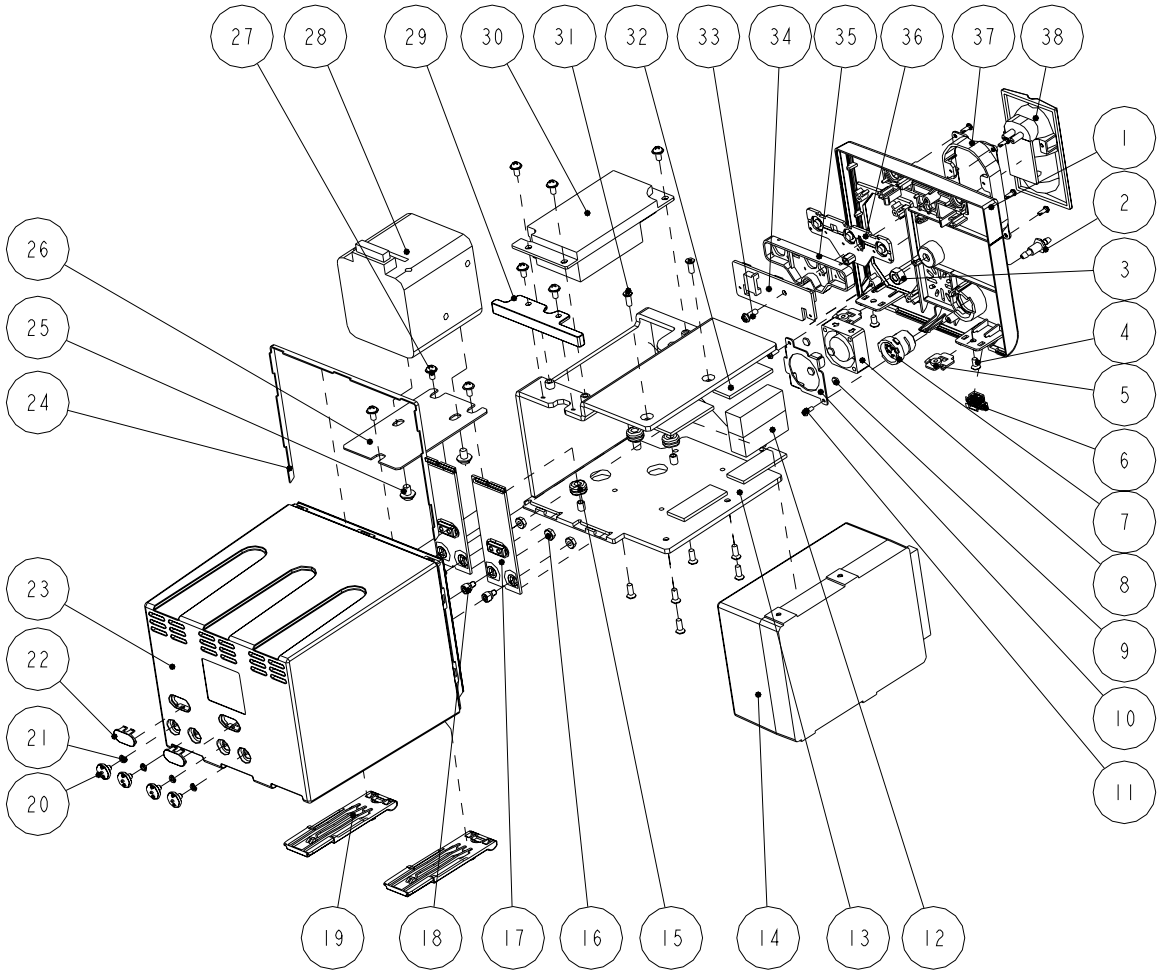


Parts List

SN	P/N	Description	Qty
1	0010-10-42826	Signal wire	1
2	6800-20-50266-51	Front panel (ICG/English)	1
3	6800-20-50284	Silicon button	1
4	6800-20-50282	Silicon button fixture	1
5	6800-30-50114	Button board	1
6	M04-003105---	Tapping screw PT3×8	1
7	0010-10-42827	ICG module PCB assembly	1
8	6800-20-50269	Left cover	1
9	6800-30-50094	Non isolating power board	1
10	6800-20-50338	Waterproof seal 01	1
11	6800-20-50268	Rear cover	1
12	6800-20-50279	Infrared light filter	1
13	M04-000104---	Spring washer	2
14	6800-20-50293	Screw	2
15	6800-20-50278	Spanner	1
16	6800-20-50292	Fixer	2
17	6800-30-50802	ICG module infrared communication board	1
18	M04-011002---	M3 NUT WITH SPRING WASHER	2
19	6800-20-50270	Right cover	1
20	M04-005005---	Crosshead screw M3×6	1
21	6800-20-50394	Snap close	1
22	6800-20-50286	Locking device	1
23	M39-059004---	Wire fixture	1

6.7.6 AG Module

Exploded View



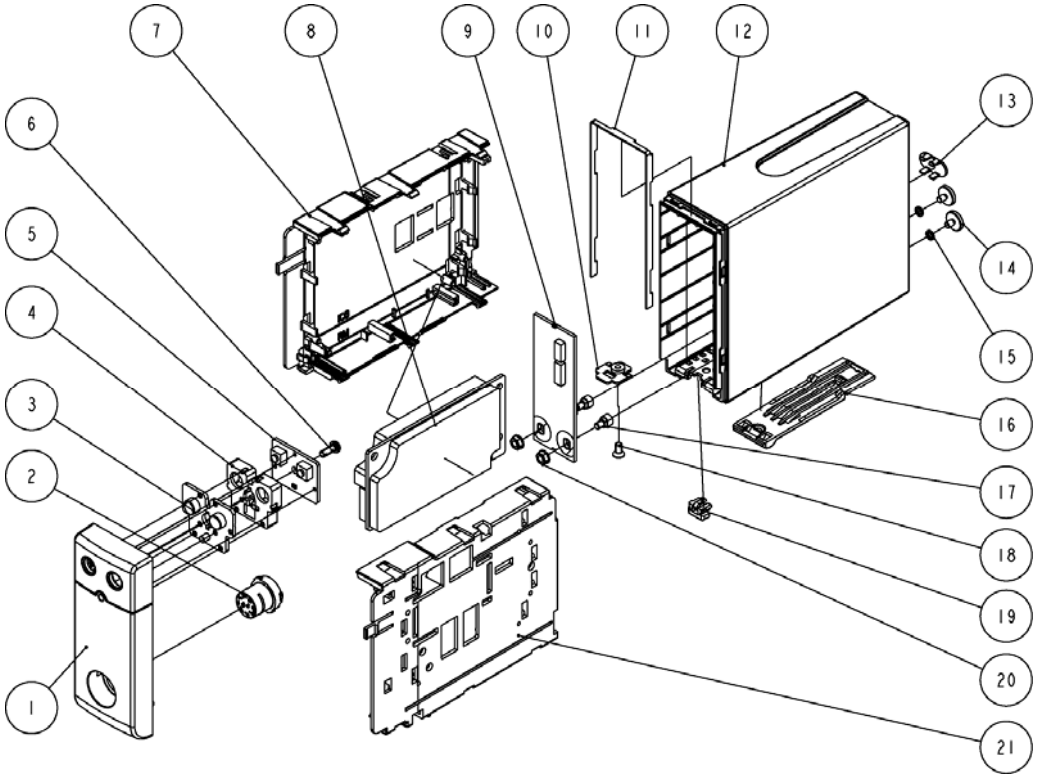
Parts List

SN	P/N	Description	Qty
1	6800-20-50276-51	AG front panel (English)	1
2	6200-20-11614	Gas outlet	1
3	M04-000501---	Stainless steel Hex nut GB/T6170-2000 M5, polished	1
4	M04-005005---	Crosshead screw M3×6	2
5	6800-20-50286	Locking device	2

6	6800-20-50394	latch	1
7	6800-21-50310	Bisx connecter cable	1
8	6800-20-50164	Module fan and cable	1
9	6800-20-50540	Module fan cushion	4
10	6800-20-50289	Fan pressing plate	1
11	M04-051003---	Crosshead tapping screw PT2X6	6
12	9200-21-10605	AG module box	1
13	6800-20-50290	Aluminium support rack	1
14	9200-10-10529	AG module	1
15	3001-10-06985	Volume measuring fixing washer (mold WSR-3149)	3
16	M04-011002---	M3 nut with spring washer	4
17	6800-30-50097	Module infrared communication backboard	2
18	6800-20-50292	Fixer	4
19	6800-20-50278	spanner	2
20	6800-20-50293	screw	4
21	M04-000104---	Spring washer	4
22	6800-20-50279	Infrared light filter	2
23	6800-20-50277	AG module rear housing	1
24	6800-20-50340	Waterproof seal 03	1
25	M04-006512---	Crosshead screw M4×6	2
26	6800-20-50291	O_2 module mount	1
27	M04-004012---	Crosshead screw M3×6	8
28	9200-10-10531	O_2 module	1
29	6800-20-50281	Infrared communication backboard support rack	1
30	6800-30-50092	Isolating power board	1
31	M04-000405---	Crosshead screw M3×8	8
32	6800-20-50699	AG module insulating pad	4
33	M04-003105---	Tapping screw PT3×8	1
34	6800-30-50118	AG/CO_2 button board	1
35	6800-20-50283	Double module button pressing plate	1
36	6800-20-50285	Double module silicone button	1
37	9200-10-10591	AG watertrap rack	1
38	9200-10-10560	AG watertrap connector (with screw/60-13510-00)	1

6.7.7 BIS Module

Exploded View

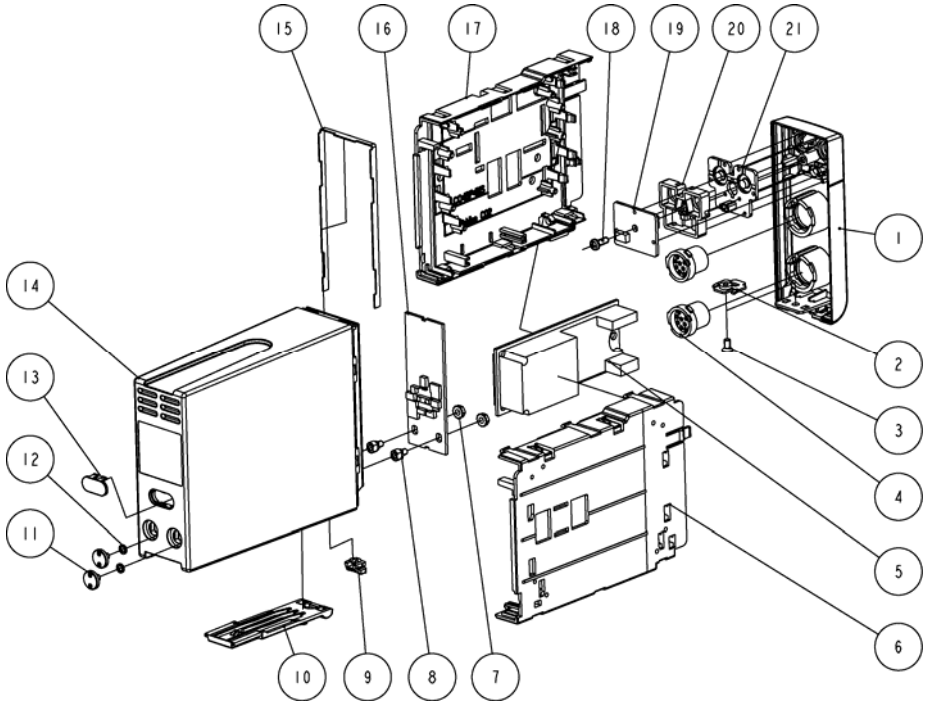


Parts List

SN	P/N	Description	Qty
1	6800-20-50264-51	Front panel（BIS/English）	1
2	6800-20-50310	BISx connector cable	1
3	6800-20-50284	Silicon button	1
4	6800-20-50282	Silicon button fixture	1
5	6800-30-50114	Button board	1
6	M04-003105---	Tapping screw PT3×8	1
7	6800-20-50269	Left cover	1
8	6800-30-50092	Isolating power board	1
9	6800-30-50800	BISX module infrared communication board	1
10	6800-20-50286	Locking device	1
11	6800-20-50338	Waterproof seal 01	1
12	6800-20-50268	Rear cover	1
13	6800-20-50279	Infrared light filter	1
14	6800-20-50293	Screw	2
15	M04-000104---	Spring washer	2
16	6800-20-50278	Spanner	1
17	6800-20-50292	Fixer	2
18	M04-005005---	Crosshead screw M3×6	1
19	6800-20-50394	Snap close	1
20	M04-011002---	M3 nut with spring washer	2
21	6800-20-50270	Right cover	1

6.7.8 IBP Module

Exploded View



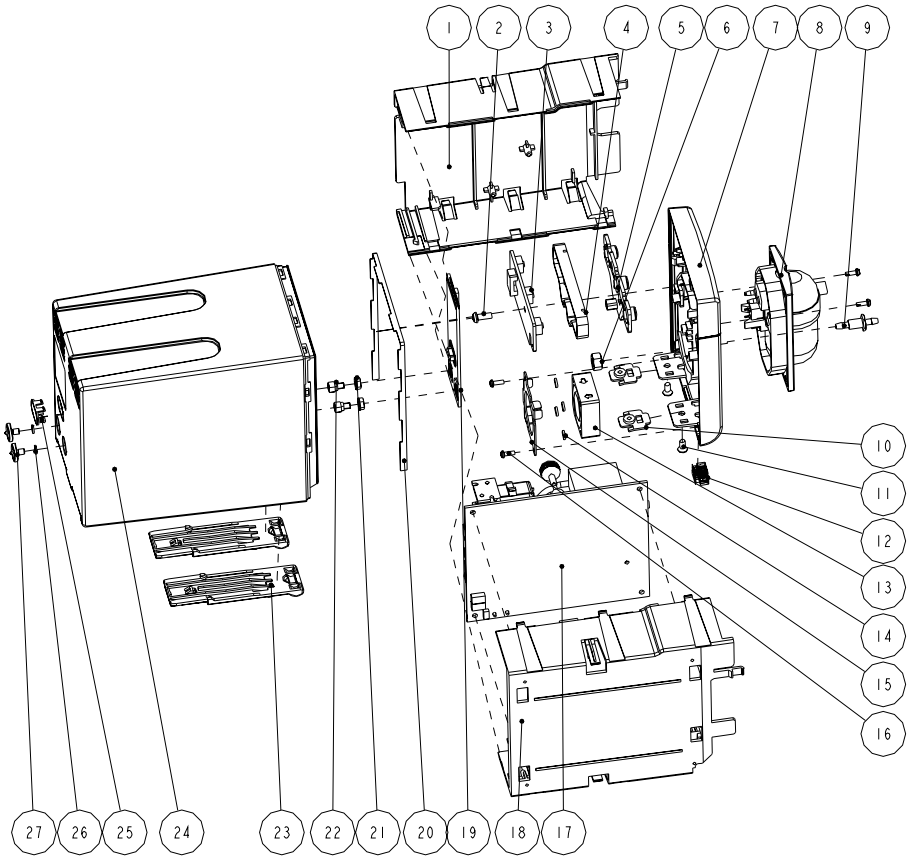
Parts List

SN	P/N	Description	Qty
1	6800-20-50265-51	Front panel (IBP/English)	1
2	6800-20-50286	Locking device	1
3	M04-005005---	Crosshead screw M3×6	1
4	6800-21-50312	IBP connector cable	2
5	M03a-30-26058	IBP board	1
6	6800-20-50269	Left cover	1
7	M04-011002---	M3 nut with spring washer	2
8	6800-20-50292	Fixer	2
9	6800-20-50394	Snap close	1
10	6800-20-50278	Spanner	1
11	6800-20-50293	Screw	2
12	M04-000104---	Spring washer	2
13	6800-20-50279	Infrared light filter	1
14	6800-20-50268	Rear cover	1

15	6800-20-50338	Waterproof seal 01	1
16	6800-30-50796	IBP module Infrared communication back board	1
17	6800-20-50270	Right cover	1
18	M04-003105---	Tapping screw PT3×8	1
19	6800-30-50114	Button board	1
20	6800-20-50282	Silicon button fixture	1
21	6800-20-50284	Silicon button	1

6.7.9 Mindray CO_2 Module

Exploded View

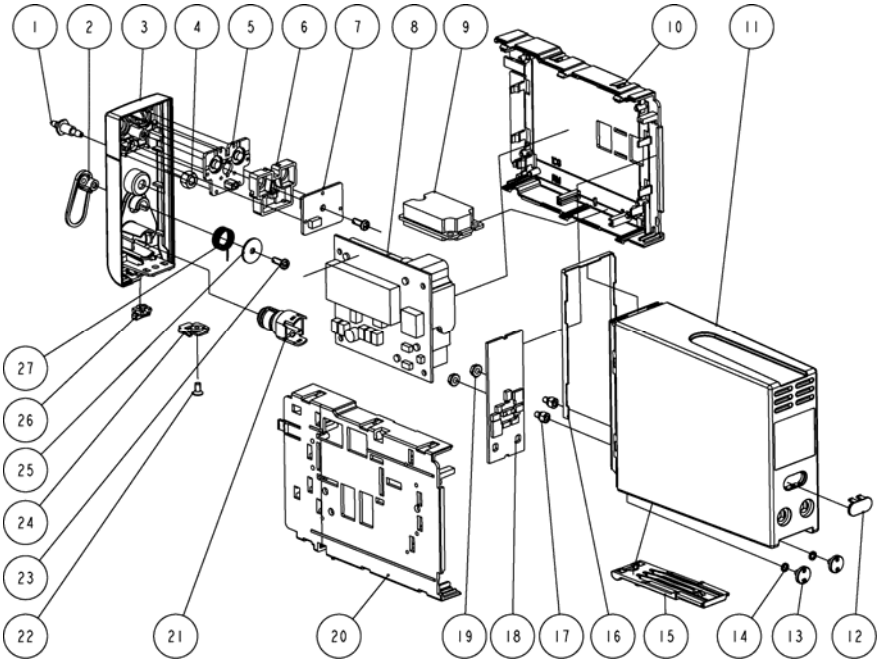


Parts List

SN	P/N	Description	Qty
1	6800-20-50275	2-slot module inner housing, right side	1
2	M04-003105---	Tapping screw PT3×8	1
3	6800-30-50116	2-slot button board	1
4	6800-20-50283	2-slot module button pressing plate	1
5	6800-20-50285	2-slot module silicone button	1
6	M04-000501---	Stainless steel nut	1
7	043-000265-00	Mindray CO_2 front panel (English)	1
8	9211-30-87429	Watertrap connector assembly (ARTEMA)	1
9	6200-20-11614	Gas outlet	1
10	6800-20-50286	Locking device	2
11	M04-005005---	Crosshead screw M3×6	2
12	6800-20-50394	Latch	1
13	6800-20-50164	Module fan and cable	1
14	6800-20-50540	Module fan cushion	4
15	6800-20-50289	Fan pressing plate	1
16	M04-051003---	Tapping screw PT2.0×6	4
17	M02B-30-64513	CO_2 main unit	1
18	6800-20-50274	2-slot module inner housing, left side	1
19	6800-30-50804	Mindray CO_2 module infrared communication board	1
20	6800-20-50339	Waterproof seal 02	1
21	M04-011002---	M3 nut with spring washer	2
22	6800-20-50292	Fixer	2
23	6800-20-50278	Snap plate	2
24	6800-20-50273	2-slot module rear housing	1
25	M04-000104---	Spring washer	2
26	6800-20-50279	Infrared light filter	1
27	6800-20-50293	Screw	2

6.7.9 Oridion CO2 Module

Exploded View



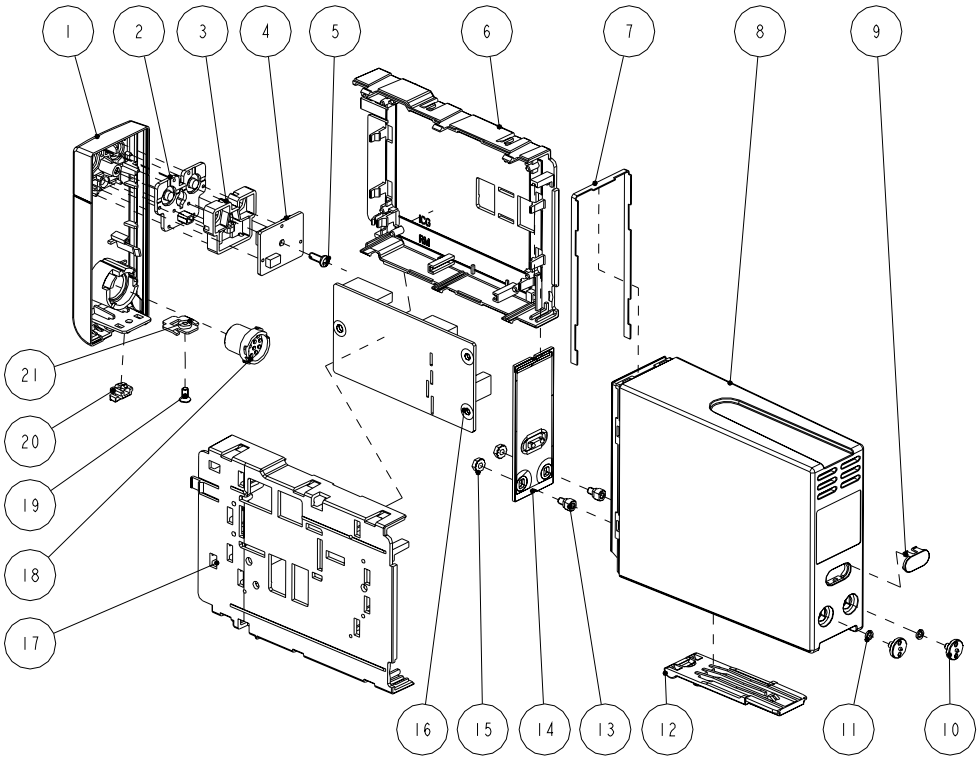
Parts List

SN	P/N	Description	Qty
1	6200-20-11614	Outlet	1
2	9201-20-35914	Connector cover	1
3	6800-20-50267-51	Front panel (microstream CO2/English)	1
4	M04-000501---	Stainless steel nut	1
5	6800-20-50284	Silicon button	1
6	6800-20-50282	Silicon button fixture	1
7	6800-30-50114	Button board	1
8	0010-10-42559	Microstream CO2 module	1
9	6800-30-50094	Non isolating power board	1
10	6800-20-50269	Left cover	1
11	6800-20-50268	Rear cover	1
12	6800-20-50279	Infrared light filter	1
13	6800-20-50293	Screw	2
14	M04-000104---	Spring washer	2

15	6800-20-50278	Spanner	1
16	6800-20-50338	Waterproof seal 01	1
17	6800-20-50292	Fixer	2
18	6800-30-50806	Oridion CO_2 module infrared communication board	1
19	M04-011002---	M3 nut with spring washer	2
20	6800-20-50270	Right cover	1
21	9201-30-35959	Connector	1
22	M04-005005---	Crosshead screw M3×6	1
23	M04-003105---	Tapping screw PT3×8	2
24	6800-20-50286	Locking device	1
25	9201-20-36010	Torsion spring washer	1
26	6800-20-50394	Snap close	1
27	9201-20-35961	Torsion spring	1

6.7.11 CCO Module

Exploded View

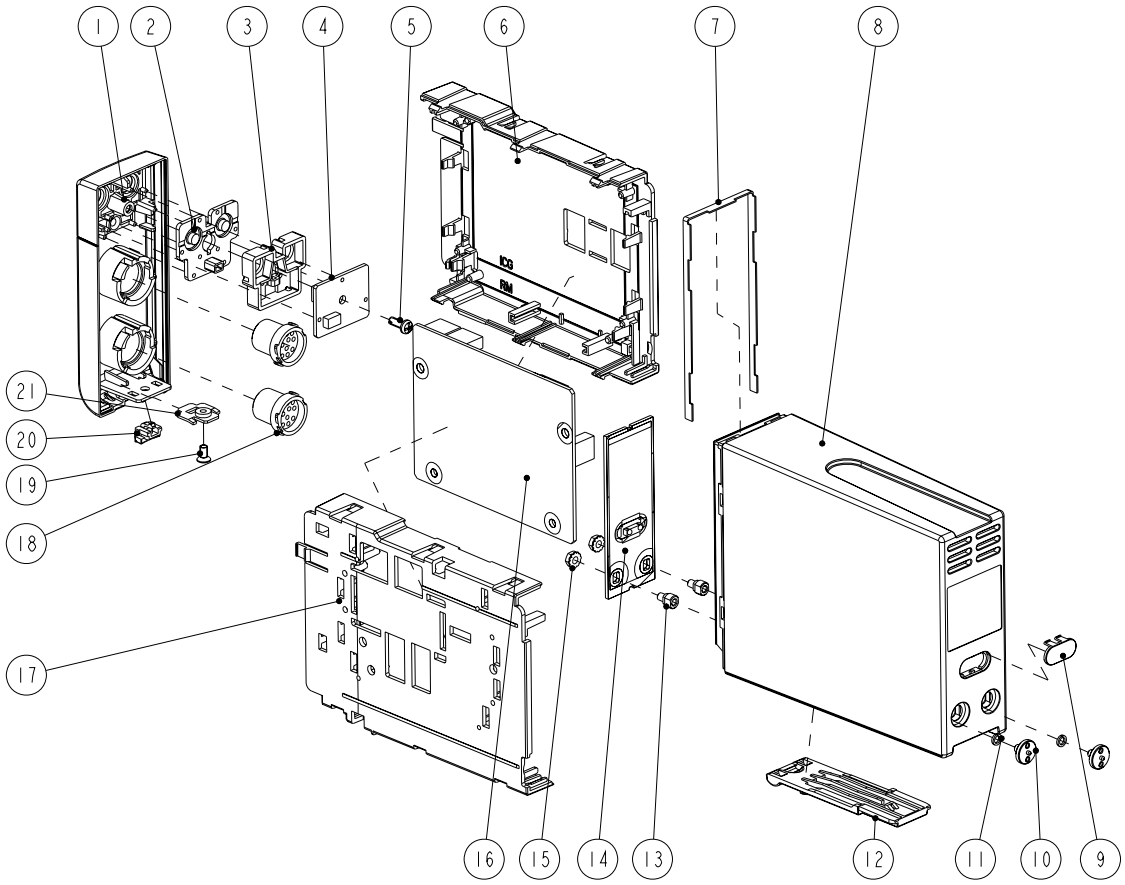


Parts List

SN	P/N	Description	Qty
1	043-000473-00	CCO/SvO_2 module front panel (English)	1
2	6800-20-50284	Silicon button	1
3	6800-20-50282	Silicon button fixture	1
4	6800-30-50114	Button board	1
5	M04-003105---	Tapping screw PT3×8	1
6	6800-20-50269	Single-slot module inner housing, left side	1
7	6800-20-50338	Waterproof seal 01	1
8	6800-20-50268	Rear cover	1
9	6800-20-50279	Infrared light filter	1
10	6800-20-50293	Screw	2
11	M04-000104---	Spring washer	2
12	6800-20-50278	Spanner	1
13	6800-20-50292	Fixer	2
14	115-003722-00	CCO/SvO_2 module infrared communication board	1
15	M04-011002---	M3 nut with spring washer	2
16	051-000184-00	CCO module board	1
17	6800-20-50270	Single-slot module inner housing, right side	1
18	009-000258-00	CCO cable	1
19	M04-005005---	Crosshead screw M3×6	1
20	6800-20-50394	Snap close	1
21	6800-20-50286	Locking device	1

6.7.12 PiCCO Module

Exploded View



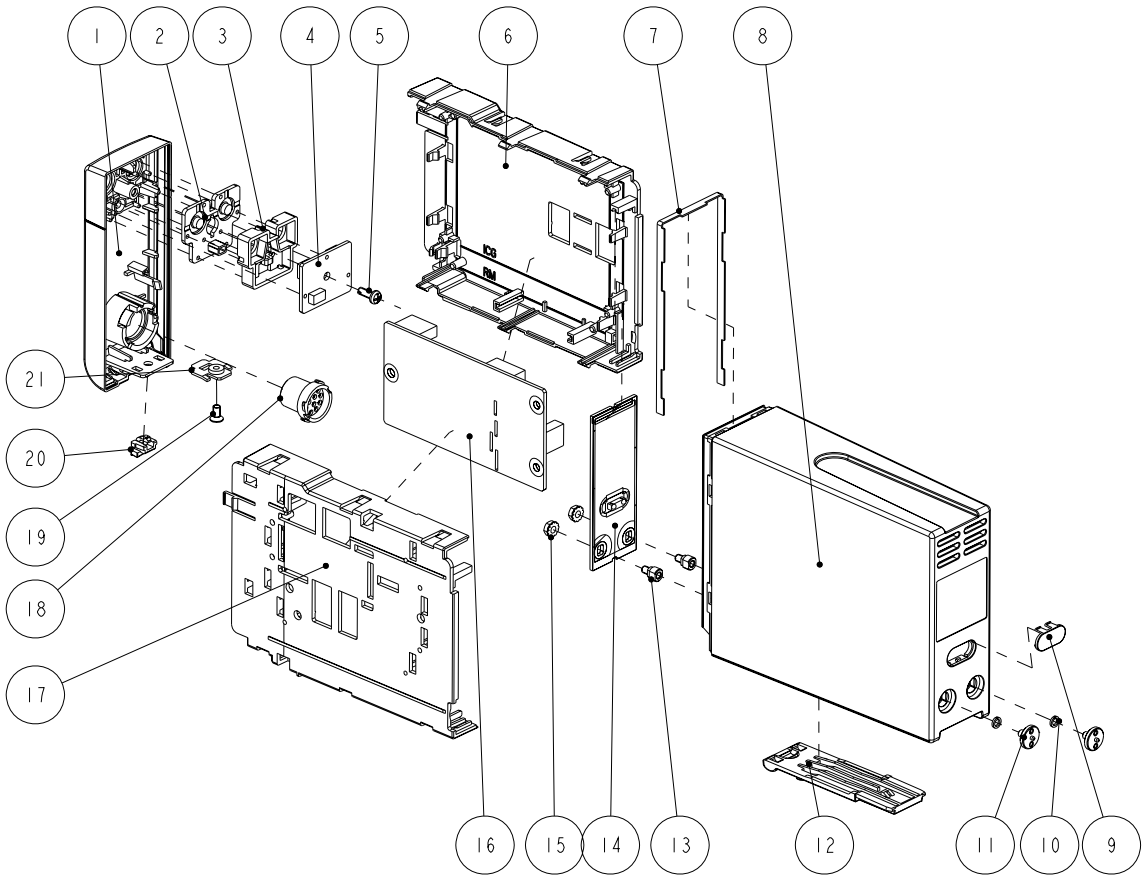
Parts List

SN	P/N	Description	Qty
1	043-000981-00	Front panel of signal module (PiCCO/English)	1
2	6800-20-50284	Silicon button	1
3	6800-20-50282	Silicon button fixture	1
4	6800-30-50114	Button board	1
5	M04-003105---	Tapping screw PT3×8	1
6	6800-20-50269	Left cover	1
7	6800-20-50338	Waterproof seal 01	1
8	6800-20-50268	Rear cover	1
9	6800-20-50279	Infrared light filter	1
10	6800-20-50293	Screw	2

11	M04-000104---	Spring washer GB93 3	2
12	6800-20-50278	Spanner	1
13	6800-20-50292	Fixer	2
14	115-007591-00	PiCCO infrared communication board	1
15	M04-011002---	M3 nut with washer	2
16	051-000502-00	PiCCO Parameter Board PCBA	1
17	6800-20-50270	Right cover	1
18	009-001253-00	PiCCO socket with signal cable	1
19	M04-005005---	Crosshead screw M3×6	1
20	6800-20-50394	Snap close	1
21	6800-20-50286	Locking device	1

6.7.13 $ScvO_2$ Module

Exploded View

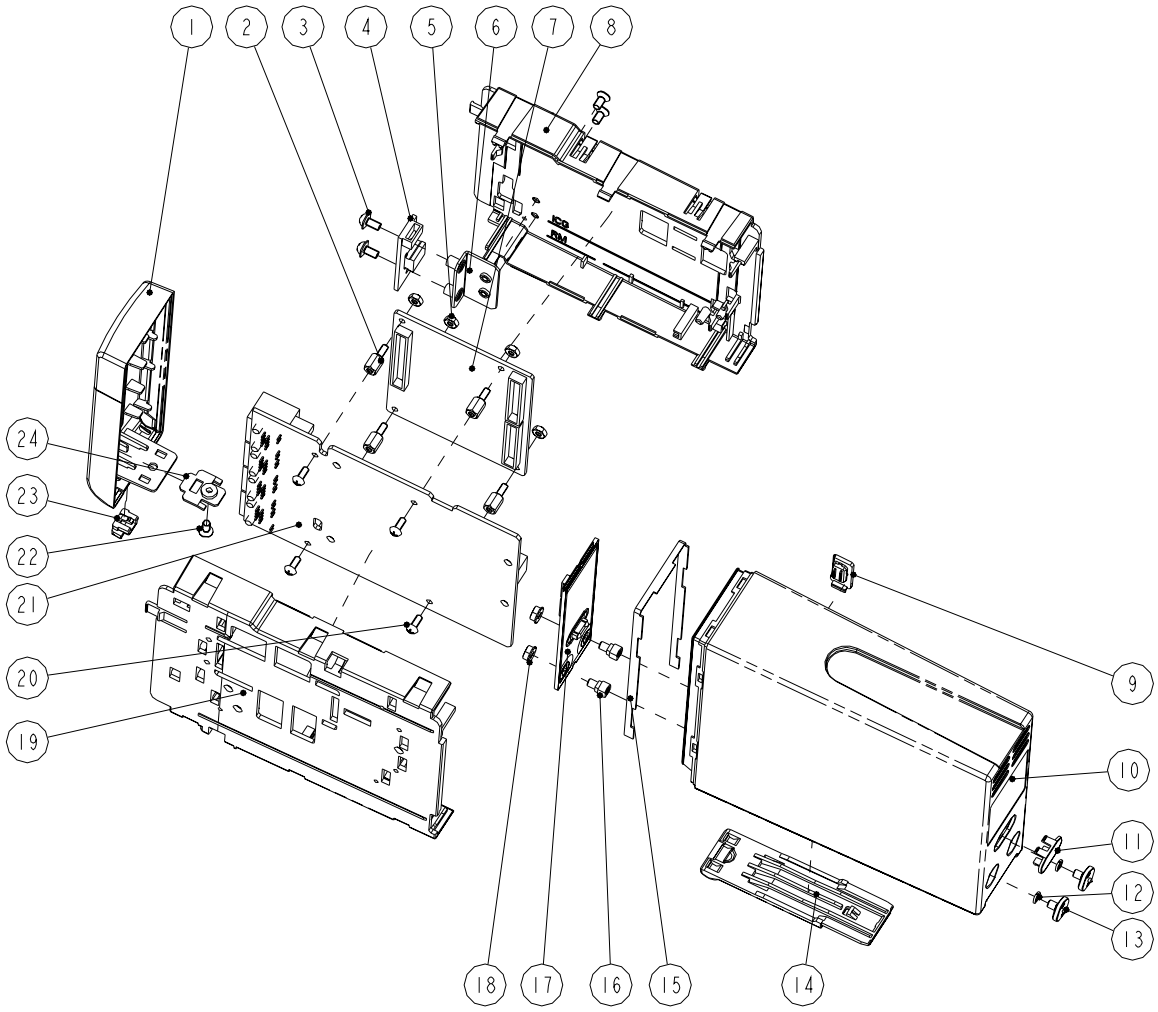


Parts List

SN	P/N	Description	Qty
1	043-000982-00	Single Module Plate($ScvO_2$/English)	1
2	6800-20-50284	Silicon button	1
3	6800-20-50282	Silicon button fixture	1
4	6800-30-50114	Button board	1
5	M04-003105---	Tapping screw PT3×8	1
6	6800-20-50269	Left cover	1
7	6800-20-50338	Waterproof seal 01	1
8	6800-20-50268	Rear cover	1
9	6800-20-50279	Infrared light filter	1
10	6800-20-50293	Screw	2
11	M04-000104---	spring washer GB93 3	2
12	6800-20-50278	Spanner	1
13	6800-20-50292	Fixer	2
14	115-007592-00	$ScvO_2$ infrared communication board	1
15	M04-011002---	M3 nut with washer	2
16	051-000537-00	$ScvO_2$ Parameter Board PCBA	1
17	6800-20-50270	Right cover	1
18	009-001255-00	$ScvO_2$ socket with signal cable	1
19	M04-005005---	Crosshead screw M3×6	1
20	6800-20-50394	Snap close	1
21	6800-20-50286	Locking device	1

6.7.14 BeneLink Module

Exploded View

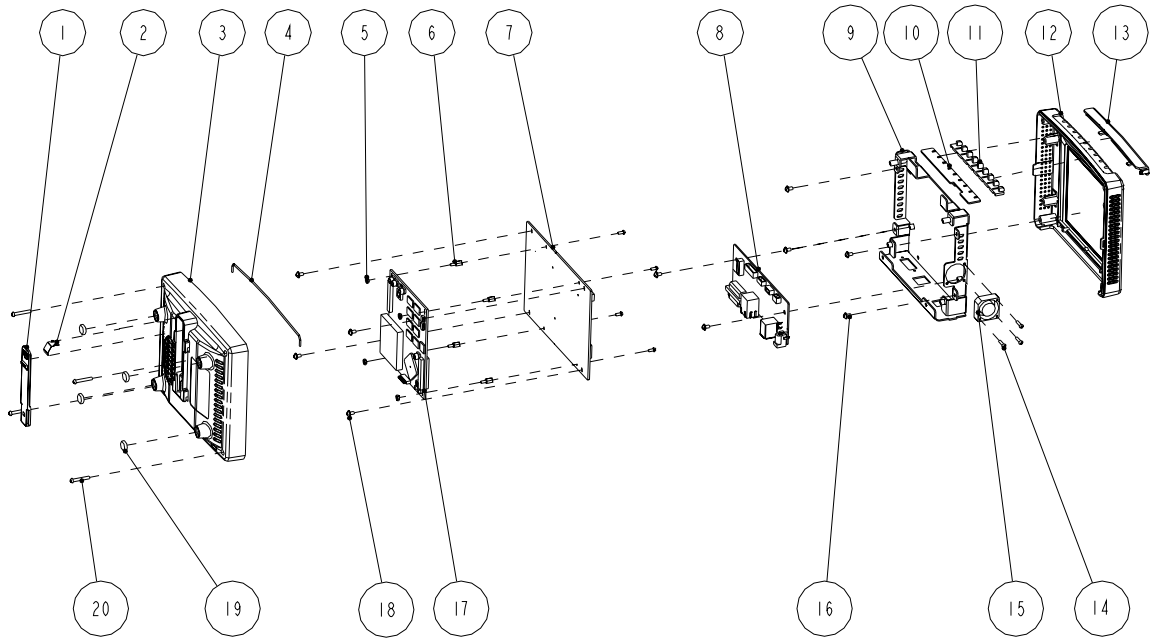


Parts List

SN	P/N	Description	Qty
1	043-001085-00	front cover of Interface	1
2	M04-060021---	Stud screw M2.5X7+6-6	4
3	M04-004012---	Screw, Pan Head W/Washer Phillips M3X6	2
4	051-000614-00	PCBA,Debug Translate Board	1
5	M04-011001---	Hex nut GB/T6170-2000M2.5	4
6	042-003249-00	usb bracket	1
7	051-000573-00	PCBA,AM1808 CPU Module	1
8	043-001128-00	left_in_shell of single module	1
9	049-000183-00	Cover	1
10	043-001127-00	back shell of single module	1
11	6800-20-50279	Infrared light filter	1
12	M04-000104---	spring washer GB93 3	2
13	6800-20-50293	Screw	2
14	6800-20-50278	Spanner	1
15	6800-20-50338	Waterproof seal 01	1
16	6800-20-50292	Fixer	2
17	051-000673-00	PCBA, Integration Module Infrared Board	1
18	M04-011002---	M3 nut with washer	2
19	6800-20-50270	Right cover	1
20	M04-051045---	Screw, M2.5x6, display	4
21	051-000571-00	PCBA, Interface Board	1
22	M04-005005---	Crosshead screw M3×6	2
23	6800-20-50394	Snap close	1
24	6800-20-50286	Locking device	1

6.8 Remote Display Box

Exploded View



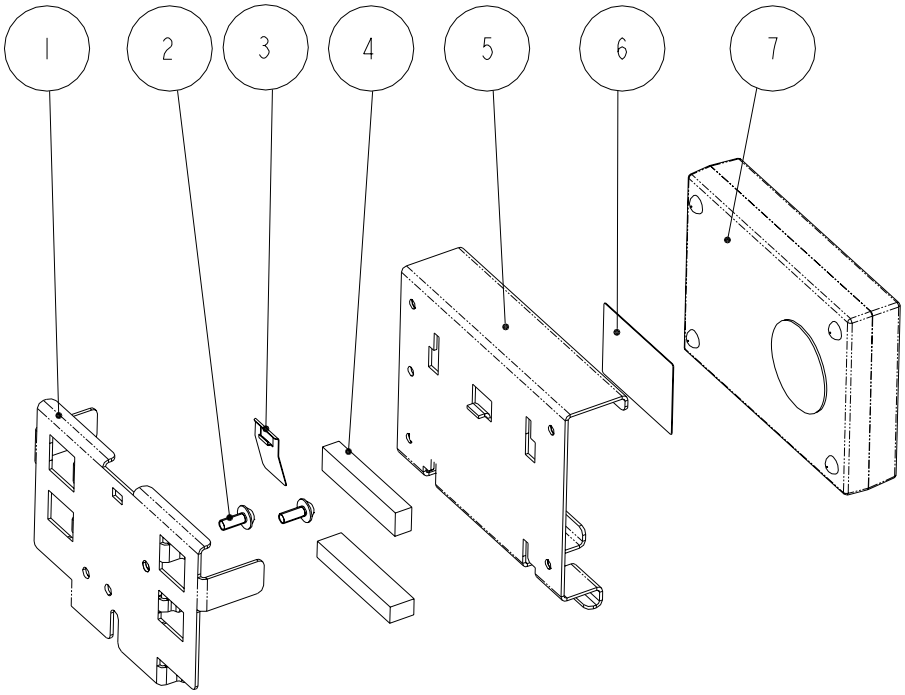
Parts List

SN	P/N	Description	Qty
1	M12A-20-75103	CIS lock catch	1
2	M12A-20-75107	Lock catch spring	1
3	M12A-21-75110	CIS bottom housing	1
4	M6G-020015---	Silicone tube	1
5	M04-011001---	Hex nut GB/T6170-2000M2.5	4
6	M04-060021---	Stud screw M2.5X7+6-6	4
7	M11A-30-75026	Remote display mother board	1
8	M11A-30-75000	Equipment interface board	1
9	M11A-20-75004-51	Remote display box rack	1
10	M12A-30-75002	Indicator board	1
11	M12A-20-75106	Light block	1
12	M12A-20-75101-51	CIS top housing	1
13	M12A-20-75102-52	Remote display box light cover	1
14	M04-004705---	Cross pan head screw M2.5X12	3

15	6800-20-50164	Module fan and cable	1
16	M04-004012---	Cross pan head screw with washer M3X6	10
17	6800-30-50058	MCF547x CPU module (basic configuration/lead-free process)	1
18	M04-051045---	Cross pan head screw M2.5X6	4
19	M12A-20-75105	CIS box cushion	4
20	M04-000505---	Cross pan head screw M3X20	4

6.9 Wireless AP

Exploded View



Part List

SN	P/N	Description	Qty
1	9201-20-36008-51 or 9201-20-35916-51(configured with Dlink AP)	(ASUS)Wireless network card fixed board Wireless network card fixed board (DLINK)	1
2	M04-004015---or M04-051147---(configured with Dlink AP)	Cross recessed small pan head screw with washer M3X8 Crosss recessed countersunk head screw M3X8	2
3	9201-20-36107	Wireless network card locking plate	1
4	9201-20-36109	Wireless network card spacer	2

5	9201-20-36009-51 or 9201-20-35917-51(configured with Dlink AP)	Wireless network card installation board (ASUS) Wireless network card installation board (DLINK)	1
6	9201-20-36110	Overlay of wireless network card fixed board	1
7	0000-10-10777 or 0000-10-11296	Wireless AP 54Mbps mini-type (ASUS) Wireless AP 2.4GHz 54Mbps(DLINK)	1

6.10 Replaceable Parts

To replace the parts, please refer to ***5 Repair and Disassembly*** and the exploded views above.

NOTE

- **Here we list most replaceable parts. If you need more parts, please contact our Customer Service Department.**

6.10.1 Main Unit

P/N	Description	Qty
Rear housing assembly		
6800-20-50194	Recorder cover	1
TR6F-30-67306	TR6F recorder	1
6800-20-50301	Recorder to main board cable	1
6800-20-50197-51	Mains container	1
6800-20-50298	Cable, power board to battery interface board	1
6800-20-50155	Cable, main unit to infrared communication board	1
051-000243-00	6800 3-slot module rack communication board	1
6800-30-50073	MPM module rack communication board	1
6800-30-50075	NiosII module	1
0000-10-11063	CF card	1
6800-20-50198-51	Key pad	1
043-000060-00	Rear housing (new interface)	1
6800-20-50672	Cable, main board to DIV interface board	1
6800-20-50673	Cable, main board to USB interface board	1
6800-30-50532 or 115-003232-00	Main board assembly	1
6800-30-50401	WLAN&CF card flexible cable	1

115-001868-00	6800 CF assembly (9211 driving board)	1
6800-30-50476 or 115-003227-00	Interface board assembly	1
6800-30-50509	Fan assembly	1
6800-20-50681	Speaker & cable	1
6800-30-50474	CIS assembly	1
Front housing assembly		
0000-10-10750 or 0000-10-11073(optional)	Inverter	1
021-000043-00 or 0000-10-11069 (optional)	LCD screen （only used together with optional inverter 0000-10-11073）	1
043-000483-00	Front bezel (T8)	1
0000-10-11071 or 0000-10-10748 (optional)	Touchscreen	1
6800-30-50082	Touchscreen control board	1
6800-30-51095(optional)	Touchscreen control board（only used together with optional touchscreen 0000-10-10748）	1
115-001328-01	Button board(1280x1024-1+anti-glare) (without shank)	1
115-001327-01	Button board (1280x1024-1+touchscreen) (without shank)	1
6800-30-50086	Alarm LED board	1
6800-30-51132	Encoder assembly (without shank)	1
Base assembly		
6800-20-50181-51	Bottom cover	1
6800-30-50108	Battery interface board	1
6800-30-50088	Power switch board	1

6.10.2 SMR

P/N	Description	Qty
6800-30-50075	NiosII module	1
6800-30-50078	SMR communication board	1
6800-30-50080	SMR interface board	1
6800-30-50667	SMR indicating lamp assembly	1
6800-20-50249-51	SMR inside assembly (BeneView)	1
6800-20-50250-51	SMR rear housing (BeneView)	1
6800-20-50251	Handle	1

6.10.3 Parameter Modules

P/N	Description	Qty
6800-30-50486	BIS Module	1
6800-30-50488	RM module	1
6800-30-50487	CAPNOSTAT CO_2 module	1
6800-30-50559	ORIDION CO_2 module	1
6800-30-50500	Mindray CO_2 module	1
6800-30-50491	ICG module	1
6800-30-50501	AG module (with O_2/BIS)	1
6800-30-50502	AG module (with O_2)	1
6800-30-50503	AG module (without O_2/BIS)	1
6800-30-50504	AG module (without O_2)	1
6800-30-50505	Manual AG module (with O_2/BIS)	1
6800-30-50506	Manual AG module (with O_2)	1
6800-30-50507	Manual AG module (without O_2/BIS)	1
6800-30-50508	Manual AG module (without O_2)	1
6800-30-50484	C.O. module	1
6800-30-50485	IBP module	1
115-007270-00	PiCCO module	1
115-007273-00	$ScvO_2$ module	1
115-007276-00	BeneLink module	1
115-007277-00	BeneLink ID adapter	1
M51A-30-80873	MPM-1 module(MINDRAYSpO_2/3/5 lead)	1

115-004900-00	MPM-2 module(MasimoSpO_2/3/5 lead)	1
M51A-30-80879	MPM-3 module(NellcorSpO_2/3/5 lead)	1
M51A-30-80880	MPM-4 module (MindraySpO_2/12 lead)	1
115-004904-00	MPM-5 module(MasimoSpO_2/12 lead)	1
M51A-30-80886	MPM-6 module(NellcorSpO_2/12 lead)	1
M51A-30-80900	MPM-7 module main unit(MindraySpO_2/3/5 lead/without IBP)	1
115-004909-00	MPM-8 module(Masimo SpO_2/3/5 lead/without IBP)	1
M51A-30-80906	MPM-9 module(Nellcor SpO_2/3/5 lead/without IBP)	1
M51A-30-80907	MPM-10 module main unit (MindraySpO_2/12 lead/without IBP)	1
115-004912-00	MPM-11 module (Masi SpO_2/12 lead /without IBP)	1
M51A-30-80913	MPM-12 module (Nell SpO_2/12 lead/without IBP)	1
115-010731-00	New MPM2 module(Masimo SpO_2/3/5lead)	1
115-010734-00	New MPM5 module(Masimo SpO_2/12lead)	1
115-010738-00	New MPM8 module(Masimo SpO_2/3/5lead/no IBP)	1
115-010740-00	New MPM11 module(Masimo SpO_2/12lead/no IBP)	1
115-010744-00	New MPM3 module(Nellcor SpO_2/3/5lead)	1
115-010747-00	New MPM6 module(Nellcor SpO_2/12lead)	1
115-010750-00	New MPM9 module(Nellcor SpO_2/3/5lead/no IBP)	1
115-010753-00	New MPM12 module(Nellcor SpO_2/12 lead)	1
115-010755-00	New MPM1 module(Mindray SpO_2/3/5lead)	1
115-010758-00	New MPM4 module(Mindray SpO_2/12lead)	1
115-010761-00	New MPM7 module(Mindray SpO_2/3/5lead/no IBP)	1
115-010764-00	New MPM10 module(Mindray SpO_2/12lead/no IBP)	1

6.10.4 Cables

P/N	Description	Remarks
Main unit		
6800-20-50156	Alarm LED board cable	
6800-20-50157	Touchscreen control board cable	
6800-20-50159	Power switch & LED board cable	
6800-20-50298	Cable from power board to battery interface board	
6800-20-50301	Cable from recorder to main board	
6800-20-50304	DVI interface board signal wire	DVI interface board to CIS assembly

6800-20-50305	power board DC output cable	
6800-20-50333	CIS mother board flat wire	Mother board to CIS mother board
6800-20-50334	17” LCD flat wire	Mother board to LCD
6800-21-50337	AC input filter cable	
6800-20-50513	Main unit Fan cable	
6800-20-50672	Cable from mother board to DVI interface board	
6800-20-50673	Cable from mother board to USB interface board	
6800-20-50681	Speaker & cables	
6800-30-50124	Integral module rack flexible cable,	Mother board to integral module rack
6800-30-50126	Button board flexible cable	Mother board to button board
6800-20-50401	WLAN card flexible cable	Mother board to CF&WLAN assembly
SMR and parameter modules		
6800-20-50155	Main unit infrared communication board cable (integral module rack)	
6800-20-50160	Button board cable	
6800-20-50161	Cable from infrared communication board to RS232 connector	
6800-20-50162	Infrared communication board TTL cable	
6800-20-50164	Module fan & cable	
6800-20-50167	SMR LED cable	
6800-20-50170	Cable from inverter to button board	from inverter to button board
6800-20-50306	AG cable	
6800-20-50309	ICG communication cable	
6800-21-50310	BIS interface cable	
6800-21-50311	CO interface cable	
6800-21-50312	IBP interface cable	
6800-21-50313	Mainstream CO_2 interface cable	
6800-20-50315	ICG power cord	
6800-20-50316	RM infrared detection board cable	
6800-20-50319	Cable from SMR to main unit	
6800-20-50662	gas pump cable	NIBP pump to parameter board

6800-20-50663	Fast-release valve cable	Fast-release valve to parameter board
6800-20-50664	Slow-release valve cable	Slow-release valve to parameter board
6800-20-50674	Cable from ICG module to infrared communication board	
6800-20-50683	Mindray CO_2 infrared communication cable	
6800-20-50690	CIS Hard disk cable	
6800-30-50128	Mindray SpO_2 flexible cable kit	
6800-30-50132	Nellcor SpO_2 flexible cable kit	
6800-30-50130	Masimo SpO_2 flexible cable kit	
040-000125-00	Patient Interface Cable (BIS module service part)	
040-000674-00	For service only, BISx Kit (186-0199-MR)	
040-000675-00	For service only, BISx4 Kit (186-1030-MR)	
040-000676-00	For service only, BISx Host Cable (186-0201-MR)	
009-001770-00	RJ45 connecting cable	
009-001767-00	Serial port adapting cable, type A	
009-001768-00	Serial port adapting cable, type B	
009-001769-00	Serial port adapting cable, type C	
009-001765-00	Cable, Infrared Board to Interface Board	
009-001254-00	AP&CVP socket with signal cable	
009-001253-00	PiCCO socket with signal cable	
009-001255-00	$ScvO_2$ socket with signal cable	
009-002220-00	Cable for infrared Communication board	

7 Upgrade

7.1 Introduction

You can upgrade parameter modules, functional assemblies and software by connecting the patient monitor to a PC running the System Update Tool.

NOTE

- **If you have to disassemble the patient monitor for software upgrade, be sure to eliminate the static charges before disassembling the equipment. When disassembling the part labeled with a ESD warning symbol, make sure you are wearing electrostatic discharge protection such as antistatic wristband or gloves to avoid damaging the equipment.**
- **Properly connect and route the cables and wires when reassembling the equipment to avoid short circuit.**
- **Select appropriate screws to assemble the equipment. If unfit screws are tightened by force, the equipment may be damaged and the screws or part may fall off during use, causing unpredictable equipment damage or human injury.**
- **Follow correct sequence to disassembly the equipment. Otherwise, the equipment may be damaged permanently.**
- **Disconnect all the cables before disassembling any parts. Be careful not to damage any cables or connectors.**
- **Properly place removed screws and disassembled parts, preventing them from being lost or contaminated.**

7.2 Upgrading Parameter Modules

You can upgrade the following parameter modules:

Parameter module	PN	Description	Remark
MPM module	M51A-30-80873	MPM-1Module(Mindray SpO_2, 3/5lead)	/
	115-004900-00	MPM-2 Module (Masimo MS-2011, 3/5lead)	
	M51A-30-80879	MPM-3 Module (Nellcor SpO_2, 3/5 lead)	
	M51A-30-80880	MPM-4 Module (Mindray SpO_2, 12 lead)	
	115-004904-00	MPM-5 Module (Masimo MS-2011, 12 lead)	
	M51A-30-80886	MPM-6 Module (NellcorSpO_2, 12 lead)	
	M51A-30-80900	MPM-7Module(Mindray SpO_2, 3/5 lead, no IBP)	
	115-004909-00	MPM-8Module(Masimo MS-2011, 3/5 lead, no IBP)	
	M51A-30-80906	MPM-9Module(NellrSpO_2, 3/5 lead, no IBP)	
	M51A-30-80907	MPM-10Module(MindraySpO_2, 12 lead, no IBP)	
	115-004912-00	MPM-11Module(Masimo MS-2011, 12 lead, no IBP)	
	M51A-30-80913	MPM-12Module(NellSpO_2, 12 lead, no IBP)	
New MPM module	115-010731-00	MPM2 module(Masimo SpO_2, 3/5lead)	
	115-010734-00	MPM5 module(Masimo SpO_2, 12lead)	
	115-010738-00	MPM8 module(Masimo SpO_2, 3/5lead, no IBP)	
	115-010740-00	MPM11 module(Masimo SpO_2, 12lead, no IBP)	
	115-010744-00	MPM3 module(Nellcor SpO_2, 3/5lead)	
	115-010747-00	MPM6 module(Nellcor SpO_2, 12lead)	
	115-010750-00	MPM9 module(Nellcor SpO_2, 3/5lead, no IBP)	
	115-010753-00	MPM12 module(Nellcor SpO_2, 12 lead)	
	115-010755-00	MPM1 module(Mindray SpO_2, 3/5lead)	
	115-010758-00	MPM4 module(Mindray SpO_2, 12lead)	
	115-010761-00	MPM7 module(Mindray SpO_2, 3/5lead, no IBP)	
	115-010764-00	MPM10 module(Mindray SpO_2, 12lead, no IBP)	
IBP module	6800-30-50850	IBP module upgrade package (without accessories)	/

C.O. module	6800-30-50849	C.O. module upgrade package (without accessories)	/
CO_2 module	6800-30-50139	M02B CO_2 module upgrade package (for adult and pediatric patients, with accessories)	Sidestream
	6800-30-50141	M02B CO_2 module upgrade package (for neonatal patient, with accessories)	Sidestream
	6800-30-50820	Oridion CO_2 module upgrade package (with accessories)	Microstream
	6800-30-50852	Capnostat CO_2 module upgrade package (with accessories)	Mainstream
AG module	6800-30-50841	AG module upgrade package (with O_2, BIS, and accessories	/
	6800-30-50842	AG module upgrade package (with O_2 and accessories	/
	6800-30-50843	AG module upgrade package (without O_2, with BIS and accessories	/
	6800-30-50844	AG module upgrade package (without O_2, with accessories	/
ICG module	6800-30-50854	ICG module upgrade package (with accessories)	/
BIS module	6800-30-50427	BIS module upgrade package (for pediatric patients, with accessories)	/
	6800-30-50880	BIS module upgrade package (with accessories)	/
RM module	6800-30-50853	RM module upgrade package (with accessories)	/
CCO/SvO_2 module	801-6800-00104-00	CCO/SvO_2 module upgrade package	/
PiCCO Module	115-007589-00	PiCCO function upgrade kit	
$ScvO_2$ Module	115-007590-00	$ScvO_2$ function upgrade kit	

You can plug and unplug parameter modules during patient monitoring.
Refer to the Operator's Manual for the use of parameter modules.

7.3 Upgrading Functional Assemblies

You can upgrade the following functional assemblies:

Functional assembly	PN	Description	Remark
SMR	6800-30-50641	SMR kit	/
Wireless network	801-6800-00108-00	6800 wireless network upgrade kit	Internal AP, for standard- configured patient monitor
	801-6800-00109-00	6800 wireless network upgrade kit	Internal AP, for fully configured patient monitor
	801-6800-00002-00	Wireless network adaptor kit	External AP
Recorder	6800-30-50856	Recorder upgrade kit	/
Analog output	801-6800-00093-00	DVI interface board (FRU)	/
CIS	801-6800-00110-00	CIS kit (InfoNode-OR)	For standard-configured patient monitor
	801-6800-00114-00	CIS kit (InfoNode-OR)	For fully configured patient monitor
	801-6800-00135-00	T8/T6 power board with heat-conductive glue	

The patient monitor can be connected to network through wireless AP. Authorized personnel are required to connect and set up the wireless network, and then carry out the performance test.

7.3.1 Upgrading SMR

The SMR can be connected to the patient monitor through SMR connector via a SMR cable. Refer to the Operator’s Manual for detail.

7.3.2 Upgrading Wireless Network Function

Refer to Section 5.4.7 to install the wireless network assembly in your patient monitor. Refer to the Operator’s Manual for the use of wireless network.

7.3.3 Upgrading Recorder

Refer to Section 5.4.16 to install the recorder in your patient monitor.
Refer to the Operator's Manual for the use of recorder.

7.3.4 Upgrading Analog Output

Refer to Section 5.4.16 to replace the interface board assembly and DVI interface board.
Refer to the Operator's Manual for use of the analog output.

7.3.5 Upgrading CIS

Refer to Section 5.4.13 to install CIS kit in your patient monitor.
Refer to the Operator's Manual for the use of CIS

NOTE

- **When upgrading wireless network, analog output and CIS function for a patient monitor with standard configuration, you have to replace old PCBAs in the patient monitor with corresponding PCBAs included in the upgrade kit and remove the covers of related connectors.**

7.4 Upgrading Software

You can upgrade the software with the System Update Tool (PN: 110-000493-00) through network. This tool can directly run on a PC. Through network or by connecting the patient monitor to a PC via a crossover network cable, you can upgrade the following programs:

Software	PN	Description	Remark
Boot program	6800-30-50770	BIOS program	Bootstrap program for monitor main control unit, implementing hardware drive and initialization For CE
	110-001594-00	BIOS program	For FDA
System software	110-000414-00	System software	CE
	6800-30-50701	System software	FDA
Multilingual library	110-000421-00	Language library	CE
	6800-30-50702	Language library	FDA
BMP resource file	110-000422-00	Icon library	CE
	6800-30-50767	Icon library	FDA
	110-000810-00	Startup Logo	CE
	6800-30-50704	Startup Logo	FDA
FPGA program	6800-30-50706	FPGA configuration chip software for mother board (MDDR)	FDA
	110-000813-00	6800FPGA configuration chip software for mother board (MDDR)	CE
Audio data file	110-001423-00	Audio data software for mother board	CE
	6800-30-50872	Audio data software for mother board	FDA
Module rack program	6800-30-50863	FPGA configuration chip software for Module rack NIOS board	/
MPM module program	0010-30-43083	BIOS program for parameter module(BF531)	The System Update Tool for MPM
	M51A-30-80950	DSP board M25P16 software for M51A module	

	M51A-30-80951	DSP board LPC2131 software for M51A module	
	M51A-30-80952	7024 software for M51A module ECG board	
	110-000539-00	SpO_2 module software for 9008	
	M51A-30-80953	7024 software for M51A module SpO_2 board	
	M51A-30-80956	M25P16 software for M51A module DSP board, Mortara algorithm	
New MPM module program	110-001979-00	BIOS program for parameter module(BF512)	The System Update Tool for M51A_2
	110-001839-00	M51A V2.0 DSP(BF512) software	
	110-001978-00	M51A V2.0 DSP(Mortara) software	
	110-001842-00	9008 V2.0 SpO_2 software	

7.4.1 How to Upgrade Software

Before software upgrade, check software version by selecting [Main Menu] → [Maintenance>>] → [Factory Maintenance>>] → enter the required password → [Software Version>>]. If your BIOS program has a version prior to 2.0, upgrade it to version 2.0 or greater before upgrading other programs. If you use System Update Tool (PN: 110-000493-00) version 2.0 or greater, make sure that BIOS program version is 2.0 or greater before upgrade. Please refer to the following procedure to upgrade the software:

1. Connect the patient monitor to a PC through a crossover network cable. Set the IP to 77.77.1.XX, the subnet mask to 255.255.255.0.
2. Run the System Update Tool in the PC. Select [BeneView] in the [Machine Type Selection] window and confirm.
3. Select [Select Package] in the main screen of the Mindray Patient Monitor Software Upgrade Tool. Choose the package you want to upgrade and click [Start].
4. Start up the patient monitor and press quickly the [Silence]+[Main Menu] hardkeys to enter upgrade mode. Determine if the software is upgraded successfully according to the prompt message of the patient monitor when finishing upgrading the software.

If your BIOS program has a version prior to 5.0(CE) or 4.2.0(FDA), you should press [Silence**]** hardkey before you start the patient monitor, and do not release it until you enter the upgrade screen.
Software upgrade is taken in the sequence of BIOS program → system software package (including system software, language library, and BMP resource files) → FPGA package (including mother board FPGA software and audio data files) → module rack FPGA package → MPM module software.

7.4.1.1 Upgrading BIOS program

If your BIOS program is version 1.2 or prior, the patient monitor has a blank screen during software upgrade. For BIOS program version greater than 1.2, the patient monitor enters the upgrade screen and presents related prompts during software upgrade.

For example, to upgrade BIOS program from version 2.0 to 3.0 or greater,

1. Run the System Update Tool, version 3.0.
2. Download the BIOS upgrade program (110-000296-00). Create a system package using the BIOS upgrade program and download it to the patient monitor. Turn off the patient monitor after you finish downloading the package.
3. Select BIOS package version 3.0 or greater, and then select the “Start” button on the System Update Tool screen. Turn on the patient monitor by pressing the power switch (you are not allowed to press other buttons at same time). Thus you can upgrade the BIOS program to version 3.0.

It should be noted that the patient monitor shows a blank screen for about 20 seconds when you turn on the patient monitor for the first time after successful software upgrade. This is because the new BIOS program is restoring the master boot from backup BIOS program.

7.4.1.2 Upgrading System Software

To upgrade system software version 02.02.00 or prior, BIOS program version 2.0 or greater and System Update Tool version 2.0 or greater are required.
The language library and icon library shall be upgraded at same time when system software is upgraded.

7.4.1.3 Upgrading FPGA Program

If your FPGA program is version 1.0, first you have to upgrade it to version 2.0 using the System Update Tool version 1.4, and then upgrade it to the latest version using the System Update Tool version 2.0 or greater.
Because two display memory models are available for the mother board, there are two mother board FGPA programs. The two FGPA programs can be created into one package to upgrade the FPGA programs for mother boards equipped with different display memories.
The audio data file shall be upgraded at same time when FPGA program is upgraded.

For details, refer to the help and instructions included in the System Update Tool, or consult your service personnel.

⚠CAUTION

- **Disconnect the patient monitor from patient and make sure important data are saved before upgrade.**
- **Do not shut down or power off the equipment when upgrading the BIOS program and FPGA program. Otherwise, the equipment may break down.**
- **Program upgrade should be performed by qualified service personnel only.**

NOTE

- **After upgrading the BIOS program, you have to upgrade system program and other programs to ensure compatibility.**
- **Make sure the version of the upgrade package is you desired one. If you want to obtain the latest upgrade package, contact Mindray Customer Service Department.**
- **To upgrade the MPM module from Mindray ECG algorithm to Mortara ECG algorithm, you have to send the MPM module to manufacture.**

A Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PROXL International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe such as Fluke, Metron, or Gerb may require modifications to the procedure. Follow the instructions of the analyzer manufacturer.

The consistent use of a safety analyzer as a routine step in closing a repair or upgrade is emphasized as a mandatory step if an approved agency status is to be maintained. The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

A.1 Power Cord Plug

- The Power Plug

Test Item		Acceptance Criteria
The power plug	The power plug pins	No broken or bent pin. No discolored pins.
	The plug body	No physical damage to the plug body.
	The strain relief	No physical damage to the strain relief. No plug warmth for device in use.
	The power plug	No loose connections.
The power cord		No physical damage to the cord. No deterioration to the cord.
		For devices with detachable power cords, inspect the connection at the device.
		For devices with non-detachable power cords, inspect the strain relief at the device.

A.2 Device Enclosure and Accessories

- Visual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

- Contextual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

A.3 Device Labeling

Check the labels provided by the manufacturer or the healthcare facility are present and legible.

- Main unit label
- Integrated warning labels

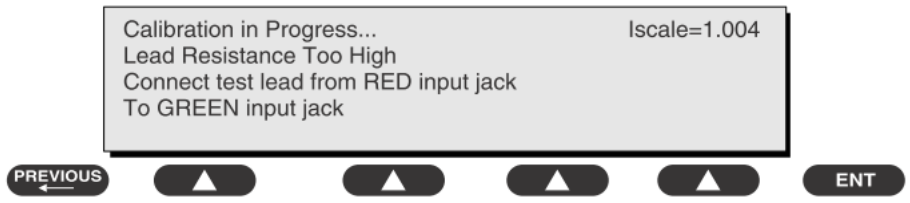
A.4 Protective Earth Resistance

Protective Earth Resistance is measured using the RED test lead attached to the DUT Protective Earth terminal or enclosure. Select the test current by pressing SOFT KEY 3 to toggle between 1AMP, 10AMP, and 25AMP. The front panel outlet power is turned off for this test.

The following conditions apply: L1 and L2 Open.

Preparation

1. First select the test current that will be used for performing the Protective Earth Resistance test by pressing AMPERES (SOFT KEY 3).
2. Connect the test lead(s) between the RED input jack and the GREEN input jack.
3. Press CAL LEADS. The 601PRO will measure the lead resistance, and if less than 0.150 Ohms, it will store the reading and subtract it from all earth resistance readings taken at the calibrated current.



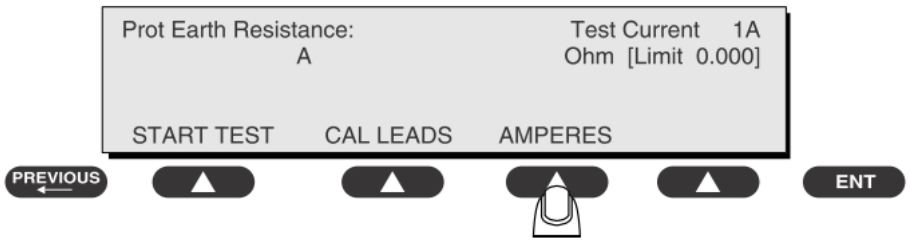
If the calibration fails, the previously stored readings will be used until a passing calibration has occurred.:

⚠WARNING

- **During Earth Resistance testing, the DUT must be plugged into the 601PRO front outlet. If the DUT fails Earth Resistance, discontinue tests and label the device defective.**

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet.
2. Attach the 601PRO RED input lead to the device's Protective Earth terminal or an exposed metal area.
3. Press shortcut key 3. The Protective Earth Resistance test is displayed.
4. Press SOFT KEY 3 to select a test current (1AMP, 10AMP, or 25AMP). The selected test current is displayed in the upper right corner of the display.



5. Press START TEST to start the test. The test current is applied while resistance and current readings are taken. This takes approximately 5 seconds.
6. Press the print data key at any time to generate a printout of the latest measurement(s).

NOTE

- **When "Over" is displayed for Ohms, this signifies that a valid measurement was not obtained because either an open connection was detected or that the measurement was not within range. Readings greater than 9.999 Ohms will be displayed as Over.**

In Case of Failure

Once it reaches the limitation, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

ALL COUNTRIES R = 0.2Ω Maximum

A.5 Earth Leakage Test

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

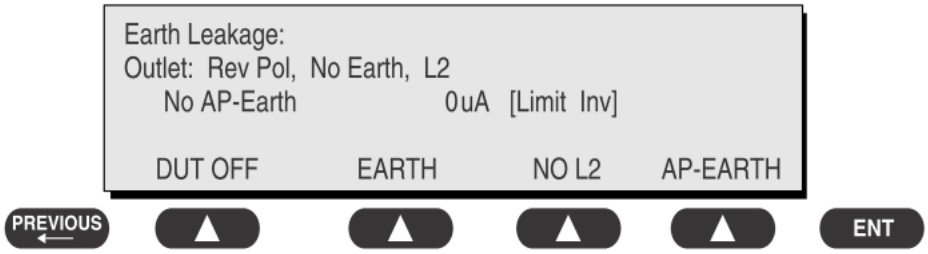
Leakage current is measured the following ways:

- Earth Leakage Current, leakage current measured through DUT outlet Earth
- Earth Leakage Current AP-EARTH (ALL Applied Parts connected to Earth), leakage current measured through DUT outlet Earth

There is no need to attach a test lead; the 601PRO automatically connects the measuring device internally.

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
2. Attach the device's applied parts to the 601PRO applied part terminals if applicable.
3. Press shortcut key 4.The Earth Leakage test appears on the display, and the test begins immediately:



- SOFT KEY 1 toggles the DUT outlet Polarity from Normal to Off to Reverse.
- SOFT KEY 2 toggles the DUT outlet from Earth to No Earth.
- SOFT KEY 3 toggles the DUT outlet from L2 to No L2.
- SOFT KEY 4 toggles the AP to Earth to No AP to Earth.

4. Press the print data key at any time to generate a printout of the latest measurement.

In Case of Failure

- Check any broken of the enclosure. Replace any defective part.
- Inspect wiring for bad crimps, poor connections, or damage.
- Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.
- Change another probe to confirm if the fail is caused by console.
- Inspect wiring for bad crimps, poor connections, or damage.
- If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.
- If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

USA:	300 μA Normal Condition
	1000 μA Single Fault Condition
OTHER COUNTRIES:	500 μA Normal Condition
	1000 μA Single Fault Condition

A.6 Patient Leakage Current

Patient leakage currents are measured between a selected applied part and mains earth. All measurements may have either a true RMS or a DC-only response.

Preparation

Perform a calibration from the Mains on Applied Part menu.

The following outlet conditions apply when performing this test:

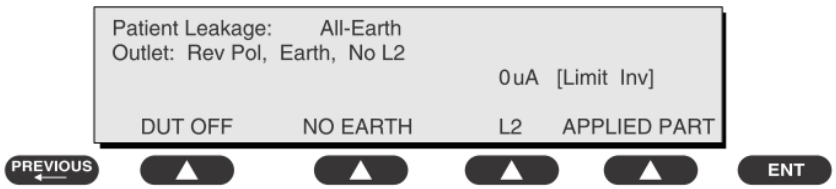
- Normal Polarity, Earth Open, Outlet ON Normal Polarity, Outlet ON
- Normal Polarity, L2 Open, Outlet ON Reversed Polarity, Outlet ON
- Reversed Polarity, Earth Open, Outlet ON Reversed Polarity, L2 Open, Outlet ON

⚠WARNING

- **If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.**

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
2. Attach the applied parts to the 601PRO's applied part terminals.
3. Press shortcut key 6. The Patient Leakage test is displayed, and the test begins immediately.



4. Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current.
5. Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO.
6. Press the print data key at any time to generate a printout of the latest measurement.

NOTE

- **If the current test standard being used does not include Patient Leakage DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections. Refer to Chapter 8, Standards and Principles.**

In Case of Failure

- Check any broken of the enclosure. Replace any defective part.
- Inspect wiring for bad crimps, poor connections, or damage.

- Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.
- Change another probe to confirm if the fail is caused by console.
- Inspect wiring for bad crimps, poor connections, or damage.
- If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.
- If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

USA:

For ECG Input and ECG Input and other applied parts

- 10μA Normal Condition
- 50μA Single Fault Condition

OTHER COUNTRIES:

For ECG Input (Defibrillator proof)

- 10μA Normal Condition
- 50μA Single Fault Condition

For ECG Input and other applied part

- 100μA Normal Condition
- 500μA Single Fault Condition

A.7 Mains on Applied Part Leakage

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions as indicated on the display.

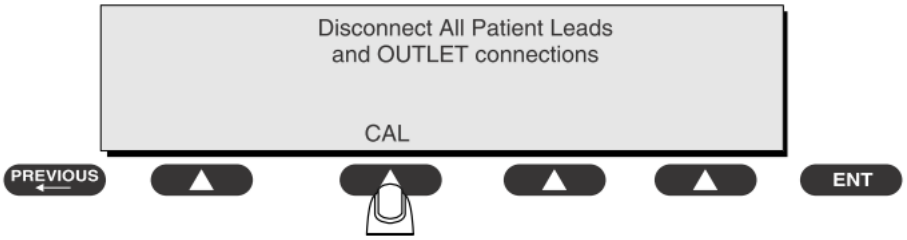
The following outlet conditions apply when performing the Mains on Applied Part test.

- Normal Polarity;
- Reversed Polarity

Preparation

To perform a calibration from the Mains on Applied Part test, press CAL (SOFT KEY 2).

1. Disconnect ALL patient leads, test leads, and DUT outlet connections.
2. Press CAL to begin calibration, as shown:



   If the calibration fails, the previously stored readings will be used until a passing calibration has occurred. Also, the esc/stop key has no effect during calibration.

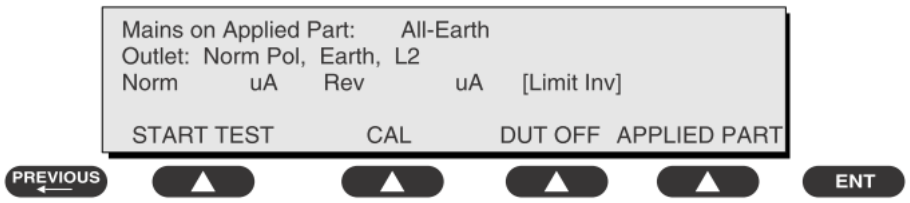
3. When the calibration is finished, the Mains on Applied Part test will reappear.

⚠WARNING

- **A 2-beep-per-second signal indicates high voltage present at the applied part terminals while a calibration is being performed.**
- **High voltage is present at applied part terminals while measurements are being taken.**

To Perform the Test

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601
2. Attach the applied parts to the 601PRO applied part terminals.
3. Attach the red terminal lead to a conductive part on the DUT enclosure.
4/ Press shortcut key 7. The Mains on Applied Part test is displayed.



5. Select the desired outlet configuration and applied part to test using the appropriate SOFT KEYS:
6. Press START TEST (SOFT KEY 1) to begin the test.
7. Press the print data key to generate a printout of the latest measurement.

NOTE

- **If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.**

In Case of Failure

- Check any broken of the enclosure. Replace any defective part.
- Inspect wiring for bad crimps, poor connections, or damage.
- Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.
- Change another probe to confirm if the fail is caused by console.
- Inspect wiring for bad crimps, poor connections, or damage.
- If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.
- If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

USA

For ECG Input and ECG Input and other applied parts
50μA

OTHER COUNTRIES:

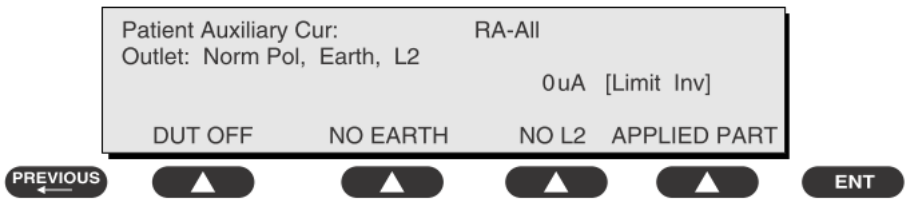
For ECG Input
50µA
For ECG Input and other applied parts
5000µA

A.8 Patient Auxiliary Current

Patient Auxiliary currents are measured between any selected ECG jack and the remaining selected ECG jacks. All measurements may have either a true RMS or a DC-only response.

Preparation

1. From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
2. Attach the patient leads to the 601PRO ECG jacks.
3. Define the Lead Types from the View Settings Option (refer to: Lead Type Definitions in Section 5 of this chapter).
4. Press shortcut key 8. The Patient Auxiliary Current test is displayed, and the test begins immediately. Display values are continuously updated until another test is selected.



5. Press SOFT KEYS 1-4 to select leakage tests
6. Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current:
7. Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO:
8. Press the print data key at any time to generate a printout of the latest measurement.

NOTE

- **If the current test standard being used does not include Patient Auxiliary Current DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections.**

In Case of Failure

- Check any broken of the enclosure. Replace any defective part.
- Inspect wiring for bad crimps, poor connections, or damage.
- Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.
- Change another probe to confirm if the fail is caused by console.
- Inspect wiring for bad crimps, poor connections, or damage.
- If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.
- If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

USA

For ECG Input and ECG Input and other applied part

- 10μA Normal Condition
- 50μA Single Fault Condition

OTHER COUNTRIES:

For ECG Input

- 10μA Normal Condition
- 50μA Single Fault Condition

For ECG Input

- 100μA Normal Condition
- 500μA Single Fault Condition

A.9 Functional test

For functional test items, please refer to relevant functional tests in *Chapter 3 Testing and Maintenance.*

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ELECTRICAL SAFETY INSPECTION FORM

American version

Overall assessment:

□	Scheduled inspection	Test item: 1, 2, 3, 9
□	Unopened repair type	Test item: 1, 2, 3, 9
□	Opened repair type, not modify the power part including transformer or patient circuit board	Test item: 1, 2, 3, 4, 5, 9
□	Opened repair type, modify the power part including transformer or patient circuit board	Test item: 1, 2, 3, 4, 5, 6, 7, 8, 9

Location				Technician	
Equipment				Control Number	
Manufacturer		Model		SN	
Measurement equipment /SN				Date of Calibration	
INSPECTION AND TESTING				Pass/Fail	Comments
1	Power Cord Plug				
2	Device Enclosure and Accessories				
3	Device Labeling				
4	Protective Earth Resistance		Ω		Max 0.2 Ω
5	Earth Leakage		—	—	Max NC:300μA SFC:1000μA
	Normal condition(NC)		μA		
	Single Fault condition(SFC)		μA		
6*	Patient Leakage Current		—	—	Max NC:10μA, SFC: 50μA
	Normal condition(NC)		μA		
	Single Fault condition(SFC)		μA		
7*	Mains on Applied Part Leakage				Max 50μA
8*	Patient Auxiliary Current		—	—	Max NC:10μA, SFC: 50μA
	Normal condition(NC)				
	Single Fault condition(SFC)				
9	Functional test (parameters tested):				

Note: The test items marked "*" are needed only for incoming inspections and after repairs or modifications that may have affected lead leakage [NFPA 99 (2005)8.5.2.1.3].

Deficiency / Note:

Name: _____ Date / Signature:_____

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ELECTRICAL SAFETY INSPECTION FORM

International version

Overall assessment:

□ Scheduled inspection Test item: 1, 2, 3, 9

□ Unopened repair type Test item: 1, 2, 3, 9

□ Opened repair type, not modify the power board and patient circuit board Test item: 1, 2, 3, 4, 5, 9

□ Opened repair type, modify the power board or patient circuit board Test item: 1, 2, 3, 4, 5, 6, 7, 8, 9

Location				Technician	
Equipment				Control Number	
Manufacturer		Model		SN	
Measurement equipment /SN				Date of Calibration	
INSPECTION AND TESTING				Pass/Fail	Comments
1	Power Cord Plug				
2	Device Enclosure and Accessories				
3	Device Labelling				
4	Protective Earth Resistance	Ω			Max 0.2 Ω
5	EARTH Leakage	—		—	Max
	Normal condition(NC)	μA			NC:500μA
	Single Fault condition(SFC)	μA			SFC:1000μA
6*	Patient Leakage Current	—		—	Max
	Normal condition(NC)	μA			CF AP
	Single Fault condition(SFC)	μA			NC:10μA, SFC: 50μA BF AP NC:100μA, SFC: 500μA
7*	Mains on Applied Part Leakage				Max CF AP: 50μA BF AP: 5000μA
8*	Patient Auxiliary Current	—		—	Max
	Normal condition(NC)				CF AP
	Single Fault condition(SFC)				NC:10μA,SFC: 50μA BF AP NC:100μA, SFC: 500μA
9	Functional test (parameters tested):				

Note: The test items marked "*" are needed only for incoming inspections and after repairs or modifications that may have affected lead leakage [NFPA 99 (2005)8.5.2.1.3].

Deficiency / Note:

Name: _____ Date / Signature: _____